



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

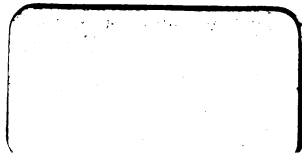
Educ T
119
01.550

Educ T 119.01.550

**HARVARD COLLEGE
LIBRARY**

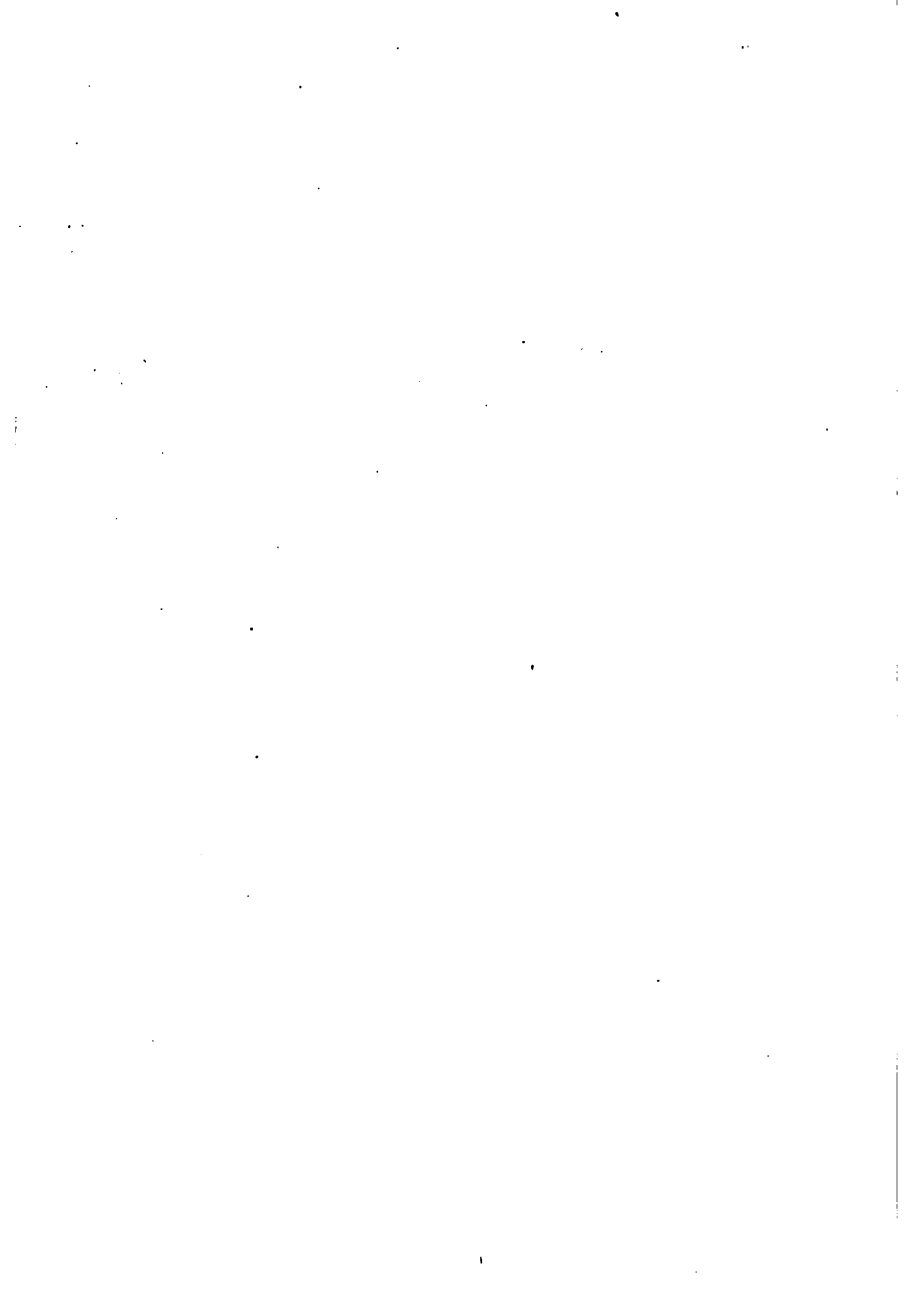


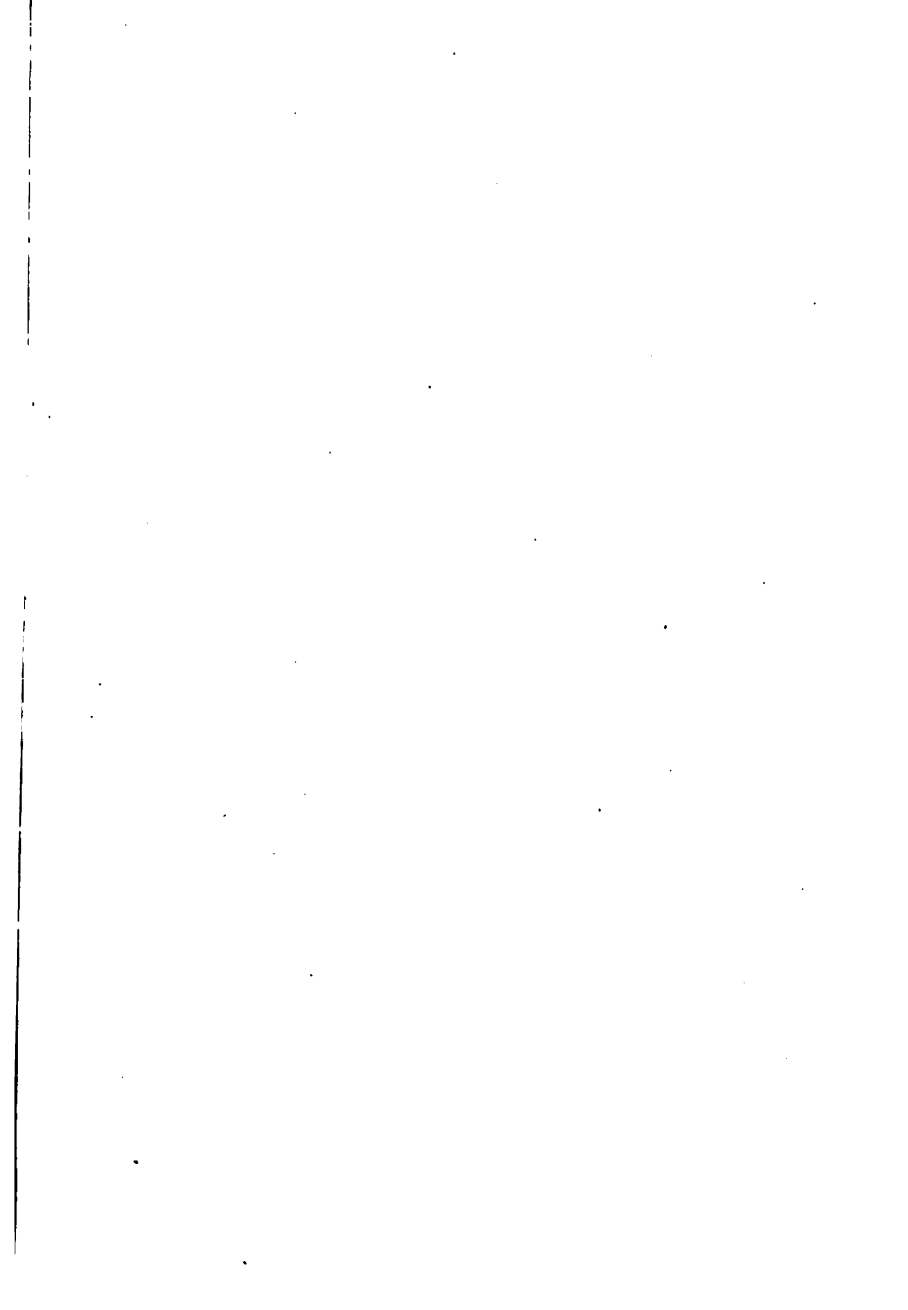
**GIFT OF THE
GRADUATE SCHOOL
OF EDUCATION**





3 2044 097 004 956







0

A KEY

TO THE

STANDARD ARITHMETIC

AND THE

MENTAL ARITHMETIC

BY

WILLIAM J. MILNE, PH.D., LL.D.
PRESIDENT OF NEW YORK STATE NORMAL COLLEGE, ALBANY, N.Y.



NEW YORK ·· CINCINNATI ·· CHICAGO
AMERICAN BOOK COMPANY

Eduet 119.01.550

v

RECEIVED LIBRARY
GIFT OF THE
GRADUATE SCHOOL OF EDUCATION
OCT 11 1930

COPYRIGHT, 1898 AND 1901, BY
AMERICAN BOOK COMPANY

E-P 8

A KEY

TO THE

STANDARD ARITHMETIC.



NOTATION AND NUMERATION.

Page 20.

XVII = 17; XXV = 25; LXXX = 80; XIX = 19; XXIX = 29;
XLV = 45; CXV = 115; XCV = 95; LXXIX = 79; CXIX = 119;
XCIX = 99; XLIV = 44; CCCIV = 304; CCXLIV = 244;
CCCCXC = 490; DCCLXXXIX = 789; $\overline{\text{XDCCLXXII}}$ = 10872.

13 = XIII; 24 = XXIV; 71 = LXXI; 68 = LXVIII;
132 = CXXXII; 514 = DXIV; 244 = CCXLIV; 555 = DLV;
617 = DCXVII; 1040 = MXL; 7216 = $\overline{\text{VMMCCXVI}}$;
2899 = MMDCCCXCIX.

THE PARENTHESIS.

Page 83.

3. $3 + 4 = 7$; $7 \times 8 = 56$.
4. $3 + 4 = 7$; $8 - 5 = 3$; $7 \times 3 = 21$.
5. $5 + 7 = 12$; $4 - 2 = 2$; $12 \div 2 = 6$.
6. $8 + 3 = 11$; $6 - 2 = 4$; $11 - 4 = 7$.
7. $9 - 3 = 6$; $7 - 5 = 2$; $6 - 2 = 4$.
8. $(3 + 4) \times 5 = 35$; $(5 + 4) + 3 = 8$; $35 - 3 = 32$.
9. $(6 + 8) + 2 = 7$; $3 \times 5 = 15$; $7 + 15 + 4 = 26$.
10. $7 \times 4 = 28$; $28 + 3 = 31$; $(12 - 4) + 2 = 4$; $31 - 4 = 27$.

4 A KEY TO THE STANDARD ARITHMETIC.

11. $2 + 12 + 4 = 5$; $7 + 8 + 4 = 9$; $9 + 3 = 8$; $5 - 3 = 2$.
 12. $(3 + 4) \times 5 = 35$; $(4 + 10) + 2 = 7$; $35 - 7 = 28$; $28 - 7 = 21$.
 13. $325 + 20 = 345$; $415 - 232 = 183$; $345 - 183 = 162$; $162 - 47 = 115$.
 14. $532 - 40 = 492$; $315 - 116 + 7 = 206$; $492 - 206 = 286$; $286 + 35 = 321$.
 15. $54 - 16 = 38$; $38 \times \overline{11 + 4} = 570$; $570 - \overline{15 \times 20} = 270$.
 16. $5 \times 3 = 15$; $84 - (7 \times 6) = 42$; $42 + 15 = 57$; $57 - 3 = 54$; $54 + 9 = 63$.
 17. $4 + 11 \times 3 = 37$; $5 + 28 + 4 = 12$; $12 + 24 = 36$; $36 + 6 = 63$; $37 - 6 = 31$.

FRACTIONAL FORMS.

Page 127.

2. $\frac{11}{7} = \frac{11}{7} + \frac{7}{7} = \frac{11}{7} \times \frac{7}{7} = \frac{11}{1}$. 7. $\frac{6}{3} = 6 + \frac{3}{3} = \frac{6}{1} \times \frac{3}{3} = 10$.
 3. $\frac{12}{8} = \frac{12}{8} + \frac{8}{8} = \frac{12}{8} \times \frac{8}{8} = \frac{12}{1}$. 8. $\frac{21}{7} = 21 + \frac{7}{7} = \frac{21}{1} \times \frac{7}{7} = 27$.
 4. $\frac{11}{15} = \frac{11}{15} + \frac{7}{15} = \frac{11}{15} \times \frac{15}{15} = 1\frac{1}{3}$. 9. $\frac{25}{12} = \frac{25}{12} + 12 = \frac{25}{12} \times \frac{12}{12} = \frac{7}{15}$.
 5. $\frac{17}{14} = \frac{17}{14} + \frac{1}{14} = \frac{17}{14} \times \frac{14}{14} = 1\frac{1}{2}$. 10. $\frac{48}{15} = 48 + \frac{15}{15} = \frac{48}{1} \times \frac{15}{15} = 80$.
 6. $\frac{11}{13} = \frac{11}{13} + \frac{2}{13} = \frac{11}{13} \times \frac{13}{13} = 1\frac{2}{13}$. 11. $\frac{55}{17} = 55 + \frac{17}{17} = \frac{55}{1} \times \frac{17}{17} = 67\frac{1}{2}$.
 12. $\frac{5\frac{1}{2}}{6\frac{1}{2}} = \frac{2\frac{1}{2}}{1\frac{1}{2}} + \frac{1\frac{1}{2}}{1\frac{1}{2}} = \frac{2\frac{1}{2}}{1\frac{1}{2}} \times \frac{1\frac{1}{2}}{1\frac{1}{2}} = \frac{11}{11}$.
 13. $\frac{5\frac{1}{2}}{2} = \frac{2\frac{1}{2}}{6\frac{1}{2}} + \frac{2}{6\frac{1}{2}}$; $\frac{2}{6\frac{1}{2}} = 2 + \frac{2\frac{1}{2}}{6\frac{1}{2}} = \frac{2}{1} \times \frac{6\frac{1}{2}}{6\frac{1}{2}} = \frac{2}{6\frac{1}{2}}$; $\frac{2\frac{1}{2}}{6\frac{1}{2}} + \frac{2}{6\frac{1}{2}} = \frac{2\frac{1}{2}}{6\frac{1}{2}} \times \frac{2}{2} = 16\frac{1}{2}$.
 14. $\frac{3\frac{1}{2}}{2\frac{1}{2}} = \frac{1}{2} + \frac{2\frac{1}{2}}{2}$; $\frac{2\frac{1}{2}}{2} = \frac{1}{2} + 2 = \frac{5}{2}$; $\frac{1}{2} + \frac{5}{2} = \frac{1}{2} \times \frac{5}{5} = \frac{11}{10} = 3\frac{1}{10}$.
 15. $\frac{5\frac{1}{2}}{3} = \frac{2\frac{1}{2}}{2\frac{1}{2}} + \frac{3}{2\frac{1}{2}}$; $\frac{3}{2\frac{1}{2}} = \frac{1}{1} + \frac{1}{2} = \frac{1}{1} \times \frac{2}{2} = \frac{2}{2}$; $\frac{2\frac{1}{2}}{2\frac{1}{2}} + \frac{2}{2\frac{1}{2}} = \frac{2\frac{1}{2}}{2\frac{1}{2}} \times \frac{2}{2} = \frac{11}{14} = 3\frac{2\frac{1}{2}}{14}$.
 16. $\frac{15\frac{1}{2}}{2\frac{1}{2}} = \frac{12\frac{1}{2}}{10} + \frac{2\frac{1}{2}}{10}$; $\frac{2\frac{1}{2}}{10} = \frac{1}{4} + 10 = \frac{11}{10}$; $\frac{12\frac{1}{2}}{10} + \frac{11}{10} = \frac{12\frac{1}{2}}{10} \times \frac{10}{10} = \frac{21\frac{1}{2}}{10} = 68\frac{1}{2}$.

17. $\frac{2\frac{1}{2} \times \frac{2}{3}}{\frac{2}{3} \times 2\frac{1}{2}} = 2\frac{1}{2} \times \frac{2}{3}$ divided by $\frac{2}{3} \times 2\frac{1}{2} = 2\frac{1}{2} \times \frac{2}{3} \times \frac{3}{7} \times \frac{7}{2} = 2\frac{1}{2}$.
18. $\frac{\frac{2}{3} \times 2\frac{1}{2}}{\frac{2}{3} \times \frac{2}{3}} = \frac{2}{3} \times \frac{2}{3}$ divided by $\frac{2}{3} \times \frac{2}{3} = \frac{2}{3} \times \frac{2}{3} \times \frac{3}{2} \times \frac{3}{2} = 2\frac{1}{2}$.
19. $\frac{\frac{7}{8} \times 3\frac{1}{2}}{\frac{7}{8} \times 2\frac{1}{2}} = \frac{7}{8} \times 1\frac{1}{2}$ divided by $\frac{7}{8} \times 1\frac{1}{2} = \frac{7}{8} \times 1\frac{1}{2} \times \frac{8}{7} \times \frac{7}{1\frac{1}{2}} = 1\frac{1}{2}$.
20. $\frac{1\frac{1}{2} \times 5\frac{1}{2}}{4\frac{1}{2} \times 5\frac{1}{2}} = 1\frac{1}{2} \times 4\frac{1}{2}$ divided by $4\frac{1}{2} \times 4\frac{1}{2} = 1\frac{1}{2} \times 4\frac{1}{2} \times \frac{4}{4\frac{1}{2}} \times \frac{4}{4\frac{1}{2}} = 1\frac{1}{2}$.
21. $\frac{1\frac{7}{8} \times 11\frac{1}{8}}{\frac{1}{2} \times 9\frac{1}{8}} = 1\frac{7}{8} \times 11\frac{1}{8}$ divided by $\frac{1}{2} \times 11\frac{1}{8} = 1\frac{7}{8} \times 11\frac{1}{8} \times \frac{2}{11\frac{1}{8}} \times \frac{1}{1\frac{1}{2}} = 1\frac{7}{8}$.

FRACTIONAL RELATION OF NUMBERS.

Page 128.

19. $5\frac{1}{2} = 2\frac{1}{2}$ and $3 = 1\frac{1}{2}$; $1\frac{1}{2} = \frac{1}{2}$ of $2\frac{1}{2}$. Therefore $3 = \frac{1}{2}$ or $\frac{1}{2}$ of $5\frac{1}{2}$.
20. $5\frac{1}{2} = 2\frac{1}{2}$ and $5 = 2\frac{1}{2}$; $2\frac{1}{2} = \frac{2}{3}$ of $2\frac{1}{2}$. Therefore $5 = \frac{2}{3}$ of $5\frac{1}{2}$.
21. $7\frac{1}{2} = 4\frac{1}{2}$ and $2 = 1\frac{1}{2}$; $1\frac{1}{2} = \frac{1}{3}$ of $4\frac{1}{2}$. Therefore $2 = \frac{1}{3}$ of $7\frac{1}{2}$.
22. $6\frac{1}{2} = 3\frac{1}{2}$ and $4 = 2\frac{1}{2}$; $2\frac{1}{2} = \frac{2}{3}$ of $3\frac{1}{2}$. Therefore $4 = \frac{2}{3}$ of $6\frac{1}{2}$.
23. $4\frac{1}{2} = 1\frac{1}{2}$ and $2 = \frac{2}{3}$; $\frac{2}{3} = \frac{2}{7}$ or $\frac{2}{7}$ of $1\frac{1}{2}$. Therefore $2 = \frac{2}{7}$ of $4\frac{1}{2}$.
24. $5\frac{1}{2} = 1\frac{1}{2}$ and $3 = \frac{3}{5}$; $\frac{3}{5} = \frac{3}{15}$ of $1\frac{1}{2}$. Therefore $3 = \frac{3}{15}$ of $5\frac{1}{2}$.
25. $3\frac{1}{2} = 2\frac{1}{2}$ and $2 = 1\frac{1}{2}$; $1\frac{1}{2} = \frac{1}{2}$ of $2\frac{1}{2}$. Therefore $2 = \frac{1}{2}$ of $3\frac{1}{2}$.
26. $6\frac{1}{2} = 2\frac{1}{2}$ and $5 = 1\frac{1}{2}$; $1\frac{1}{2} = \frac{1}{6}$ or $\frac{1}{6}$ of $2\frac{1}{2}$. Therefore $5 = \frac{1}{6}$ of $6\frac{1}{2}$.
27. $8\frac{1}{2} = 4\frac{1}{2}$ and $6 = 3\frac{1}{2}$; $3\frac{1}{2} = \frac{2}{3}$ of $4\frac{1}{2}$. Therefore 6 is $\frac{2}{3}$ of $8\frac{1}{2}$.
28. $7\frac{1}{2} = 4\frac{1}{2}$ and $5 = 3\frac{1}{2}$; $3\frac{1}{2}$ is $\frac{2}{3}$ of $4\frac{1}{2}$. Therefore 5 is $\frac{2}{3}$ of $7\frac{1}{2}$.
29. $8\frac{1}{2} = 4\frac{1}{2}$ and $6 = 3\frac{1}{2}$; $3\frac{1}{2}$ is $\frac{2}{3}$ of $4\frac{1}{2}$. Therefore 6 is $\frac{2}{3}$ of $8\frac{1}{2}$.
30. $9\frac{1}{2} = 7\frac{1}{2}$ and $8 = 6\frac{1}{2}$; $6\frac{1}{2}$ is $\frac{2}{3}$ of $7\frac{1}{2}$. Therefore 8 is $\frac{2}{3}$ of $9\frac{1}{2}$.
31. $12 = 4\frac{1}{2}$; $4\frac{1}{2}$ is 20 times $\frac{1}{5}$. Therefore 12 is 20 times $\frac{1}{5}$.
32. $8 = 4\frac{1}{2}$; $4\frac{1}{2}$ is 10 times $\frac{1}{2}$. Therefore 8 is 10 times $\frac{1}{2}$.
33. $10 = 7\frac{1}{2}$; $7\frac{1}{2}$ is $11\frac{1}{2}$ times $\frac{2}{7}$. Therefore 10 is $11\frac{1}{2}$ times $\frac{2}{7}$.
34. $9 = 7\frac{1}{2}$; $7\frac{1}{2}$ is $10\frac{1}{2}$ times $\frac{2}{7}$. Therefore 9 is $10\frac{1}{2}$ times $\frac{2}{7}$.
36. $2\frac{1}{2} = 1\frac{1}{2}$ and $3\frac{1}{2} = 2\frac{1}{2}$; $2\frac{1}{2}$ is $\frac{2}{3}$ of $1\frac{1}{2}$. Therefore $3\frac{1}{2}$ is $\frac{2}{3}$ of $2\frac{1}{2}$.
37. $3\frac{1}{2} = \frac{2}{3}$ and $4\frac{1}{2} = \frac{1}{3}$; $\frac{1}{3} = \frac{1}{3}$ of $\frac{2}{3}$. Therefore $4\frac{1}{2}$ is $\frac{1}{3}$ of $3\frac{1}{2}$.
38. $4\frac{1}{2} = 3\frac{1}{2}$ and $3\frac{1}{2} = 2\frac{1}{2}$; $2\frac{1}{2}$ is $\frac{2}{3}$ of $3\frac{1}{2}$. Therefore $3\frac{1}{2}$ is $\frac{2}{3}$ of $4\frac{1}{2}$.
39. $6\frac{1}{2} = 1\frac{1}{2}$ and $3\frac{1}{2} = \frac{2}{3}$; $\frac{2}{3}$ is $\frac{2}{15}$ of $1\frac{1}{2}$. Therefore $3\frac{1}{2}$ is $\frac{2}{15}$ of $6\frac{1}{2}$.

6 A KEY TO THE STANDARD ARITHMETIC.

40. $3\frac{1}{2} = \frac{7}{2}$ and $2\frac{2}{3} = \frac{8}{3}$; $\frac{8}{3}$ is $\frac{8}{7}$ or $\frac{2}{7}$ of $\frac{7}{2}$. Therefore $2\frac{2}{3}$ is $\frac{2}{7}$ of $3\frac{1}{2}$.
41. $3\frac{2}{3} = \frac{11}{3}$ and $1\frac{1}{2} = \frac{3}{2}$; $\frac{3}{2}$ is $\frac{2}{11}$ of $\frac{11}{3}$. Therefore $1\frac{1}{2}$ is $\frac{2}{11}$ of $3\frac{2}{3}$.
42. $5\frac{2}{3} = \frac{17}{3}$ and $2\frac{2}{3} = \frac{8}{3}$; $\frac{8}{3}$ is $\frac{8}{17}$ of $\frac{17}{3}$. Therefore $2\frac{2}{3}$ is $\frac{8}{17}$ of $5\frac{2}{3}$.
43. $8\frac{2}{3} = \frac{26}{3}$ and $3\frac{2}{3} = \frac{11}{3}$; $\frac{11}{3}$ is $\frac{11}{26}$ of $\frac{26}{3}$. Therefore $3\frac{2}{3}$ is $\frac{11}{26}$ of $8\frac{2}{3}$.
44. $6\frac{1}{2} = \frac{13}{2}$ and $3\frac{1}{4} = \frac{13}{4}$; $\frac{13}{4}$ is $\frac{1}{4}$ of $\frac{13}{2}$. Therefore $3\frac{1}{4}$ is $\frac{1}{4}$ of $6\frac{1}{2}$.
45. $5\frac{2}{3} = \frac{17}{3}$ and $4\frac{1}{10} = \frac{41}{10}$; $\frac{41}{10}$ is $\frac{41}{170}$ of $\frac{17}{3}$. Therefore $4\frac{1}{10}$ is $\frac{41}{170}$ of $5\frac{2}{3}$.
46. $3\frac{2}{3} = \frac{10}{3}$ and $2\frac{1}{4} = \frac{9}{4}$; $\frac{9}{4}$ is $\frac{9}{100}$ of $\frac{10}{3}$. Therefore $2\frac{1}{4}$ is $\frac{9}{100}$ of $3\frac{2}{3}$.
47. $4\frac{2}{3} = \frac{14}{3}$ and $3\frac{1}{4} = \frac{13}{4}$; $\frac{13}{4}$ is $\frac{13}{140}$ of $\frac{14}{3}$. Therefore $3\frac{1}{4}$ is $\frac{13}{140}$ of $4\frac{2}{3}$.
48. $\frac{2}{3} = \frac{2}{3}$ and $\frac{2}{3} = \frac{2}{3}$; $\frac{2}{3}$ is $\frac{2}{3}$ of $\frac{2}{3}$. Therefore $\frac{2}{3}$ is $\frac{2}{3}$ of $\frac{2}{3}$.
49. $\frac{2}{3} = \frac{2}{3}$ and $\frac{2}{3} = \frac{2}{3}$; $\frac{2}{3}$ is $\frac{2}{3}$ of $\frac{2}{3}$. Therefore $\frac{2}{3}$ is $\frac{2}{3}$ of $\frac{2}{3}$.
50. $\frac{1}{11} = \frac{1}{11}$ and $\frac{1}{11} = \frac{1}{11}$; $\frac{1}{11}$ is $\frac{1}{11}$ of $\frac{1}{11}$. Therefore $\frac{1}{11}$ is $\frac{1}{11}$ of $\frac{1}{11}$.
51. $\frac{2}{3} = \frac{2}{3}$ and $\frac{2}{3} = \frac{2}{3}$; $\frac{2}{3}$ is $\frac{2}{3}$ of $\frac{2}{3}$. Therefore $\frac{2}{3}$ is $\frac{2}{3}$ of $\frac{2}{3}$.

Page 129.

22. Since \$450 is $\frac{1}{3}$ of his money, $\frac{1}{3}$ of it is $\frac{1}{3}$ of \$450, or \$90. Since \$90 is $\frac{1}{9}$ of the money, the money must be 9 times \$90, or \$810.

23. Since \$1260, the cost of the house, is $\frac{2}{3}$ of the cost of the store, $\frac{1}{3}$ of the cost of the store will be $\frac{1}{3}$ of \$1260, or \$420. Since \$420 is $\frac{1}{8}$ of the cost of the store, 8 times \$420, or \$3360, will be the entire cost of the store.

24. Since \$2914 is $\frac{1}{10}$ of what was received for the sheep, $\frac{1}{10}$ of the sum received for the sheep is $\frac{1}{10}$ of \$2914, or \$291.40, and the whole sum received is 10 times \$291.40, or \$2914.

25. Since \$31.50 was $\frac{1}{21}$ of what he paid for a horse, $\frac{1}{21}$ of \$31.50, or \$1.50, was $\frac{1}{21}$ of the price paid for the horse, and the price of the horse was 21 times \$1.50, or \$31.50.

26. Since $\frac{1}{8}$ of her money was \$21.65, $\frac{1}{8}$ of her money was $\frac{1}{8}$ of \$21.65, or \$2.70625, and the whole of her money was 8 times \$2.70625, or \$21.65.

27. Since 1264 books is $\frac{1}{7}$ of E's library, $\frac{1}{7}$ of E's library is $\frac{1}{7}$ of 1264 books, or 180.57 books, and his entire library is 7 times 180.57 books, or 1264 books.

Page 130.

28. Since 672 bushels was $\frac{1}{11}$ of the quantity of corn, $\frac{1}{11}$ of the quantity of corn was $\frac{1}{11}$ of 672 bushels, or 61.09 bushels, and the entire quantity of corn was 11 times 61.09 bushels, or 672 bushels.

29. Since \$2513 was $\frac{1}{12}$ of the cost of the house, $\frac{1}{12}$ of the cost of the house was $\frac{1}{12}$ of \$2513, or \$359, and the entire cost of the house was 12 times \$359, or \$4308.

30. Since 1560 bushels was $\frac{1}{7}$ of the quantity burned in October, $\frac{1}{7}$ of the quantity burned in October was $\frac{1}{7}$ of 1560 bushels, or 260 bushels, and the whole quantity burned in October was 7 times 260 bushels, or 1820 bushels.

31. Since \$376.70 was $\frac{1}{5}$ of Tuesday's sales, $\frac{1}{5}$ of Tuesday's sales was $\frac{1}{5}$ of \$376.70, or \$75.34, and the entire sales on Tuesday were 6 times \$75.34, or \$452.04.

32. Since \$1936 was $\frac{1}{11}$ of the sum he deposited in another bank, $\frac{1}{11}$ of the sum was $\frac{1}{11}$ of \$1936, or \$176, and the entire sum was 13 times \$176, or \$2288.

33. Since \$19,000 was $\frac{1}{5}$ of the value of the estate, $\frac{1}{5}$ of its value was $\frac{1}{5}$ of \$19,000, or \$9500, and the entire value of the estate was 5 times \$9500, or \$47,500.

34. Since 3300 feet is $\frac{1}{8}$ of a mile, $\frac{1}{8}$ of a mile is $\frac{1}{8}$ of 3300 feet, or 660 feet, and a whole mile is 8 times 660 feet, or 5280 feet.

35. Since \$36,000 was $\frac{1}{7}$ of the cost of the house, $\frac{1}{7}$ of the cost of the house was $\frac{1}{7}$ of \$36,000, or \$6000, and the entire cost was 7 times \$6000, or \$42,000.

36. $\frac{1}{3}$ of Mr. B's weekly income = \$48;

$\frac{1}{3}$ of Mr. B's weekly income = $\frac{1}{3}$ of \$48, or \$16.

∴ Mr. B's weekly income = 8 times \$16, or \$128.

$\frac{1}{3}$ of Mr. C's weekly income = \$60;

$\frac{1}{3}$ of Mr. C's weekly income = $\frac{1}{3}$ of \$60, or \$20.

∴ Mr. C's weekly income = 6 times \$20, or \$72.

Since Mr. B's income is \$128 and C's \$72, B's is \$56 more than C's.

37. Since \$2193 is $\frac{1}{35}$ of his resources, $\frac{1}{35}$ of his resources is $\frac{1}{35}$ of \$2193, or \$129, and his entire resources are 35 times \$129, or \$4515. Since his resources are \$4515, and he owes \$2193, he is worth \$4515 - \$2193, or \$2322.

38. Since \$4826 was $\frac{1}{20}$ of his fortune, $\frac{1}{20}$ of his fortune was $\frac{1}{20}$ of \$4826, or \$254, and his entire fortune was 20 times \$254, or \$5080.

REVIEW EXERCISES — ORAL.

Page 131.

8. $\frac{3}{4}$ of $\frac{2}{3} = \frac{1}{2}$. If a man owns $\frac{3}{4}$ of a ship and sells $\frac{1}{2}$ of it, he still owns the difference between $\frac{3}{4}$ and $\frac{1}{2}$ of the ship, or $\frac{1}{4}$ of the ship.

8. Once the height of the tree $+\frac{1}{2}$ the height, or $1\frac{1}{2}$ times the height, = 266 ft. Since $1\frac{1}{2}$ times the height, or $\frac{3}{2}$ of the height = 266 ft., $\frac{1}{2}$ of the height = $\frac{1}{3}$ of 266 ft., or 88 ft., and the height = 4 times 88 ft., or 352 ft.

11. Since a man can plow $\frac{1}{5}$ of 5 acres, or $\frac{1}{5}$ acres, in a day, in $\frac{3}{5}$ of a day he can plow $\frac{3}{5}$ of $\frac{1}{5}$ acres, or 1 acre.

Page 132.

16. Since Charles lost $\frac{2}{3}$ of his marbles, he had $\frac{1}{3}$ of them left. Since $\frac{1}{3}$ of his marbles = 21, $\frac{1}{3}$ of his marbles = $\frac{1}{3}$ of 21, or 7; and the whole number = 49. Since he had 49 marbles and lost all but 21, he must have lost 49 - 21, or 28 marbles.

18. Since I have $\frac{1}{4}$ of my land left, I have sold $\frac{3}{4}$ of it. $4\frac{1}{2}$ acres + $5\frac{1}{2}$ acres = $10\frac{1}{2}$ acres. Therefore, $10\frac{1}{2}$ acres = $\frac{1}{4}$ of my farm, and my farm must have contained 4 times $10\frac{1}{2}$ acres, or 42 acres.

19. Since 8 men eat 4 loaves in a day, one man will eat $\frac{1}{2}$ of a loaf per day. Therefore 5 men will eat $2\frac{1}{2}$ loaves in one day, and in three days they will eat 3 times $2\frac{1}{2}$ loaves, or 7 $\frac{1}{2}$ loaves.

22. Since 60 sheep were $\frac{2}{3}$ of the number left,
 20 sheep were $\frac{1}{3}$ of the number left.
 \therefore 100 sheep were left.

Since 100 sheep remained after selling 60, he must have had at first 160 sheep.

Page 133.

24. The man sold $\frac{2}{3}$ of his farm, therefore he must have had $\frac{1}{3}$ of his farm left. Since $\frac{1}{3}$ of his farm = 30 acres, $\frac{1}{3}$ of his farm = $\frac{1}{3}$ of 30 acres, or 10 acres, and the whole farm contained 3 times 10 acres, or 30 acres.

26. $\frac{1}{4}$ of \$125 = \$31.25; \$31.25 is 4 times the cost of the harness; therefore the cost of the harness is $\frac{1}{4}$ of \$31.25, or \$7.81.

32. Since $\frac{1}{3}$ of the peaches was left, $\frac{2}{3}$ must have been sold. $\frac{2}{3}$ of peaches = 28 bu., $\frac{1}{3}$ = 7 bu., and whole amount = 35 bu.

Page 134.

36. Mary's mother is 40 yr. of age. Mary is $\frac{2}{3}$ of 40 yr., or 15 yr. of age. Since 40 yr. = $\frac{1}{2}$ of her grandmother's age, $\frac{1}{2}$ of her grandmother's age = $\frac{1}{2}$ of 40 yr., or 10 yr., and her grandmother's age is 70 yr.

37. $\frac{3}{4}$ of a cord of wood @ \$6 per cd. will cost \$4 $\frac{1}{2}$, hence, it will buy as much coal @ \$8 per ton as \$8 is contained times in \$4 $\frac{1}{2}$; $4\frac{1}{2} \div 8 = \frac{9}{16} \times \frac{1}{8} = \frac{9}{128}$ of a ton.

41. Charles goes $\frac{1}{4}$ of a mile in 6 $\frac{3}{4}$ minutes, therefore it will take him 3 times 6 $\frac{3}{4}$ minutes, or 20 minutes, to go a mile; and it will take $1\frac{1}{2}$ times 20 minutes, or 30 minutes, to go a mile and a half.

43. $\frac{1}{2} + \frac{1}{4}$, or $\frac{3}{4}$, of the pole is in mud and water, consequently $\frac{3}{4} \times 100 = 75$, or $75\frac{0}{100}$, of the pole is in the air; $\frac{1}{2} \times 88 = 44$ ft., $\frac{1}{4} \times 16 = 4$ ft.; and the entire length of the pole is 20 times 4 ft., or 80 ft.

44. The hound gains 4 rods in a minute, and will take as long to gain 60 rods as 4 is contained times in 60, which is 15. Therefore it will take him 15 minutes.

Page 135.

49. He spent $\frac{1}{4}$ of his earnings, therefore had $\frac{3}{4}$ of his earnings left, which was \$15. Since $\frac{3}{7}$ of his earnings = \$15, $\frac{1}{7}$ of them = \$5, and his entire earnings = 7 times \$5, or \$35. $\$35 \div 11\frac{1}{2} = \3 , the amount received per day.

REVIEW EXERCISES—WRITTEN.

2. $\$6\frac{1}{2} + \$1\frac{1}{2} + \$3\frac{1}{2} = \$11\frac{1}{2}$, the value of the purchases;
 $\$20 - \$11\frac{1}{2} = \$8\frac{1}{2}$, the change he should receive.

3. It will require 12 times $8\frac{1}{2}$ hours, or 102 hours, to do the work, and it will take as many days to do the work, working $8\frac{1}{2}$ hours per day, as $8\frac{1}{2}$ is contained times in 102, or $11\frac{1}{2}$ days.

Page 136.

5. The quotient 347, multiplied by divisor $26\frac{1}{2} = 9065\frac{1}{2}$, the dividend.

6. A sold $\frac{2}{3}$ of his land; therefore, he had $\frac{1}{3}$ of his land left, which was $115\frac{1}{2}$ acres; therefore, $\frac{1}{3}$ of his land was $\frac{1}{2}$ of $115\frac{1}{2}$ acres, or $57\frac{1}{4}$ acres, and the entire quantity was 5 times $57\frac{1}{4}$ acres, or $289\frac{1}{4}$ acres.

10 A KEY TO THE STANDARD ARITHMETIC.

7. $1000 \text{ sq. yd.} \div 30\frac{1}{2} = 33\frac{1}{3}\frac{1}{3} \text{ sq. rods.}$

8. $\frac{1}{3}$ of the estate = \$ 5604 ;

$\frac{1}{9}$ of the estate = \$ 467 ;

The entire estate = 19 times \$ 467, or \$ 8873.

9.
$$\frac{7 + 6}{9 + 6} = \frac{13}{15};$$

$$\frac{1}{3} - \frac{1}{5} = \frac{2}{15};$$

\therefore the value of the fraction is increased $\frac{2}{15}$.

11. 450 lb. sugar @ $4\frac{1}{2}\phi$ = \$ 20.25

50 lb. tea @ $37\frac{1}{2}\phi$ = 18.75

80 lb. rice @ $8\frac{1}{2}\phi$ = 7.00

Total, \$ 46.00

12. $\frac{1}{3} + \frac{1}{10} + \frac{1}{3} + \frac{1}{4} = \frac{27}{60}$ of the quantity of sugar sold. Since he sold $\frac{27}{60}$ of the sugar, he must have had $\frac{1}{3}$ of the sugar left, which was 260 lb. $\frac{1}{3}$ of the sugar = $\frac{1}{3}$ of 260 lb., or 20 lb. ; and the entire quantity was 40 times 20 lb., or 800 lb.

13. $\frac{1}{4}$ of a section + $\frac{1}{4}$ of a section = $\frac{1}{2}$ of a section ;
 $\frac{1}{10}$ of $\frac{1}{2}$ = $\frac{1}{20}$ of a section, or C's property.

14. $\frac{2}{3} \times \frac{1}{2} \times \frac{1}{4} \times 3\frac{1}{2} + 6 \times \frac{1}{2} \times \frac{1}{2} \times 5 = \frac{2}{3} \times \frac{1}{2} \times \frac{1}{4} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 1\frac{1}{12}$.

15. \$.40 $\times 12\frac{1}{2}$ = \$ 5.10, the value of the potatoes ;

\$ 5.10 \div \$.18 $\frac{1}{2}$ = 27 $\frac{1}{2}$, number of gallons of molasses.

16. Since $\frac{1}{10}$ of the quantity leaked out, there was left $\frac{9}{10}$ of 41 $\frac{1}{2}$ gal., or 37 $\frac{7}{10}$ gal. left. Since I wish to gain \$ 1 on the purchase price, I must sell it for \$ 7.75, and since I must receive \$ 7.75 for 37 $\frac{7}{10}$ gal., each gallon will cost as much as 37 $\frac{7}{10}$ is contained times in \$ 7.75, or 20 $\frac{3}{4}$ $\frac{1}{4}$ ϕ .

Page 137.

17. \$ $\frac{9}{10} \times 6$ = \$ 5 $\frac{4}{5}$, the amount earned in one week ;

\$ 5 $\frac{4}{5}$ - \$ 3 $\frac{1}{10}$ = \$ 1 $\frac{9}{10}$, the amount saved in one week ;

\$ 1 $\frac{9}{10} \times 52$ = \$ 75 $\frac{9}{10}$, the amount saved in one year.

18. A's share, $\frac{2}{3}$, plus B's share, $\frac{1}{3}$, = $\frac{3}{3}$. Subtracting from the whole, we find that C's share was $\frac{1}{10}$. Since A owned $\frac{2}{3}$ of the stock, he received $\frac{2}{3}$ of the profit ; $\frac{2}{3}$ of \$ 4260 = \$ 1704 ; B's share was $\frac{1}{3}$ of \$ 4260, or \$ 1597 $\frac{1}{2}$, and C's $\frac{1}{10}$ of \$ 4260, or \$ 953 $\frac{1}{2}$.

19. After spending $\frac{2}{3}$ of his earnings he had $\frac{1}{3}$ of his earnings left ;
 $\frac{1}{3}$ of his earnings = \$24 ; $\frac{1}{3}$ = \$6 ; and his earnings = \$42 ; \$42 + 24 $\frac{2}{3}$
 = \$112 $\frac{2}{3}$, the sum earned per day.

20. Since $\frac{1}{8}$ of the quantity is taken for grinding, he brings back
 but $\frac{7}{8}$ of the amount taken to mill. Therefore

21 bu. = $\frac{7}{8}$ of the amount taken to mill ;

$\frac{1}{8}$ of the amount = 3 bu. ; and

the entire amount = 8 times 3 bu., or 24 bu.

21. 16 $\frac{1}{2}$ lb. @ \$.09 = \$1.50 $\frac{1}{2}$, the cost of the turkey ;

$\frac{2}{3}$ of 16 $\frac{1}{2}$ lb. = 11 $\frac{2}{3}$ lb., the weight of the turkey after dressing ;

\$1.50 $\frac{1}{2}$ + 11 $\frac{2}{3}$ $\frac{1}{3}$ = \$.12 $\frac{2}{3}$, the cost per pound of the dressed
 turkey.

24. 4 $\frac{1}{2}$ yd. + 2 $\frac{1}{2}$ yd. + $\frac{1}{2}$ yd. = 7 $\frac{1}{2}$ yd., the quantity required for 1 suit ;

45 $\frac{1}{2}$ yd. + 7 $\frac{1}{2}$ yd. = 6, the number of suits.

25. 20 sheep @ \$2 $\frac{1}{2}$ each = \$57 $\frac{1}{2}$, the amount received ;

8 yd. @ \$1 $\frac{1}{2}$ per yd. = \$12 $\frac{1}{2}$, the amount paid ;

\$44 $\frac{7}{10}$, the amount left.

26. $\frac{1}{4}$ of 100 fowls = 25 fowls, the number sold to E ;

$\frac{2}{3}$ of 75 fowls = 50 fowls, the number sold to F ;

25 fowls remained, which, sold at 25¢ apiece, brought \$6.25.

27. 2 horses will eat $\frac{1}{4}$ as much as 8 horses. Since 8 horses eat 15
 tons in 6 months, 2 horses will eat $\frac{1}{4}$ of 15 tons, or 3 $\frac{3}{4}$ tons in 6 months.

Page 138.

28. 3 $\frac{1}{4}$ mi. \times 5 $\frac{7}{8}$ = 18 $\frac{7}{8}$ mi., the distance A walked ;

4 $\frac{1}{3}$ mi. \times 4 $\frac{1}{3}$ = 17 $\frac{1}{3}$ mi., the distance B walked ;

18 $\frac{7}{8}$ mi. - 17 $\frac{1}{3}$ mi. = $\frac{69}{240}$ mi., A's distance more than B's.

29. $\frac{1}{20}$ of \$1000 = \$50, the sum spent for clothes ;

$\frac{1}{8}$ of \$1000 = \$125, the sum spent in travel ;

\$1000 - (\$50 + \$125) = \$825, the sum spent for land.

12 A KEY TO THE STANDARD ARITHMETIC.

30. Since only $\frac{2}{3}$ of the stock was destroyed by fire, $\frac{1}{3}$ of it was not thus destroyed.

$\frac{2}{3}$ of $\frac{1}{2}$ = $\frac{1}{3}$, the part of the stock destroyed by water;
 $\frac{1}{2} - \frac{1}{3} = \frac{1}{6}$, the part of the stock which remained to be sold;

$\therefore \frac{1}{6}$ of the stock = \$2575; $\frac{1}{3}$ = $\frac{1}{2}$ of \$2575, or \$1287 $\frac{1}{2}$;
 Entire value of stock = 15 times \$1287 $\frac{1}{2}$, or \$19,312 $\frac{1}{2}$.

31. $\frac{3}{4} - \frac{2}{3} = \frac{1}{12}$; $\frac{5}{8} + \frac{1}{12} = \frac{17}{24}$;

$\therefore \frac{17}{24}$ of A's money = \$1020;

$\frac{1}{24}$ of A's money = $\frac{1}{17}$ of \$1020, or \$60; and

A's money = 24 times \$60, or \$1440.

35. $2(15\frac{1}{2} \text{ ft.} + 12\frac{1}{2} \text{ ft.}) = 56\frac{1}{2} \text{ ft.}$, the distance around the room;

$\$.04\frac{1}{2} \times 56\frac{1}{2} = \$2.55\frac{1}{2}$, the cost of the moulding.

Page 139.

36. $\frac{2}{3}$ of $\frac{3}{4}$ = $\frac{1}{2}$, the part sold to B;

$\frac{1}{3}$ of $\frac{3}{4}$ = $\frac{1}{4}$, the part sold to C;

$\therefore \frac{1}{4}$ of ship = \$2500; $\frac{1}{4}$ = $\frac{1}{75}$ of \$2500, or \$33 $\frac{1}{3}$;

Total value = 75 times \$33 $\frac{1}{3}$, or \$7486 $\frac{2}{3}$.

37. $\frac{1}{3} + \frac{5}{8} + \frac{2}{3} + \frac{1}{3} = 2\frac{5}{24}$, the number of acres sold;

$4\frac{1}{2} - 2\frac{5}{24} = 1\frac{11}{8}$, the number of acres remaining;

$\$850 \times 1\frac{11}{8} = \$1662\frac{5}{8}$, the value of the remainder.

38. Since \$60 will keep 2 horses for 12 weeks, it will keep one horse 24 weeks, or \$2 $\frac{1}{2}$ will keep a horse one week; and it will cost $3\frac{1}{2}$ times as much, or \$8 $\frac{1}{2}$, to keep a horse $3\frac{1}{2}$ weeks.

39. $\frac{1}{3}$ of \$12,520 = \$4173 $\frac{1}{3}$, the value of the brothers' shares. Since one owns $\frac{2}{3}$ as much as the other, the share of the larger owner + $\frac{1}{3}$ of that amount, or $\frac{1}{2}$ of the share of the larger owner, is equal to the shares of both. Therefore

$\frac{1}{2}$ of the share of the larger owner = \$4173 $\frac{1}{3}$;

$\frac{1}{3}$ of the share of the larger owner = \$417 $\frac{1}{3}$;

Entire share of larger owner = \$2921 $\frac{1}{3}$;

$\frac{2}{3}$ of \$2921 $\frac{1}{3}$ = \$1252, the other's share.

40. \$13 $\frac{1}{2}$ + \$4 $\frac{1}{2}$ + \$3 $\frac{1}{2}$ + \$2 $\frac{7}{10}$ = \$24 $\frac{7}{10}$;

\$55 $\frac{1}{2}$ - \$24 $\frac{7}{10}$ = \$31 $\frac{7}{10}$.

41. Since he receives \$15½ for 125 lb. of iron, he receives \$12½ for 100 lb. of iron. He pays \$100 for 100 lb.; therefore he gains the difference between \$12½ and \$100, which is \$111½.

42. The carpenter and his son together build ½ of the shop in one day. The carpenter alone builds ⅓ of it in one day. ½ - ⅓ = ⅙, the part of the shop which the son can build in one day. Since he builds ⅙ of it in a day, it will take him 36 days to build the shop alone.

43. Before spending \$½ he had \$21½ left, which was ⅓ of his money. Therefore, his money was 3 times \$21½, or \$64.

$$44. \quad \frac{2}{3} \times \frac{1}{2} \times \frac{1}{3} \times \frac{1}{4} \times \frac{1}{5} \times \frac{1}{6} \times \frac{1}{7} = 12\frac{1}{42}.$$

$$46. \quad \$\frac{2}{3} \times 75 = \$56\frac{1}{2}, \text{ cost of } 75 \text{ bu.}$$

$$\quad \$\frac{1}{3} \times 65 = 40\frac{1}{3}, \text{ cost of } 65 \text{ bu.}$$

$$\quad \$\frac{1}{3} \times 20 = 13, \text{ cost of } 20 \text{ bu.}$$

$$\text{Cost of all} = \$109\frac{1}{3}. \quad 160 \text{ bu.}$$

To gain \$25 he must sell the 160 bu. for \$109⅓ + \$25, or \$134⅓, that is, for \$.84⅓ per bu.

Page 140.

47. Since there are 20 cows in the pasture, of which A owns 8 and B owns 12, A must pay ⅓ of the pasture hire, or \$6.20, and B must pay ⅔ of it, or \$9.30.

48. Since 18 sheep eat as much as 3 horses, 6 sheep will eat as much as one horse, and 48 sheep will eat as much as 8 horses. Since 48 sheep eat as much as 8 horses, 9 horses and 48 sheep will eat as much as 17 horses; therefore one must pay ⅓ of \$20, or \$10⅓, and the other ⅔ of \$20, or \$9⅔.

$$49. \quad \frac{1}{3} \text{ hr.} \times 15 = 5 \text{ hr., the time A requires;}$$

$$\quad \frac{2}{3} \text{ hr.} \times 15 = 4\frac{2}{3} \text{ hr., the time B requires;}$$

$$\quad 5 \text{ hr.} - 4\frac{2}{3} \text{ hr.} = \frac{1}{3} \text{ of an hour in favor of B.}$$

50. Since James, William, and Joseph can remove ⅓ of the wood in one hour, and James and William can remove ⅔ of it in one hour, Joseph alone can remove the difference between ⅓ and ⅔, or ⅙ of the wood in one hour. He can, therefore, remove the wood alone in 36 hours.

14 A KEY TO THE STANDARD ARITHMETIC.

51. 130 barrels @ $\$6\frac{2}{3}$ per barrel = $\$866\frac{2}{3}$, the money paid ;
 85 barrels @ $\$6\frac{9}{10}$ per barrel = $\$586\frac{1}{2}$;
 45 barrels @ $\$7$ per barrel = $\$315$.
 $\$586\frac{1}{2} + \$315 = \$901\frac{1}{2}$, the sum received.
 $\$901\frac{1}{2} - \$866\frac{2}{3} = \$34\frac{1}{6}$, the gain.

52. Since $\frac{2}{3}$ of A's money = $\frac{2}{3}$ of B's, $\frac{1}{3}$ of A's money = $\frac{1}{3}$ of B's, and A's money = $\frac{1}{10}$ of B's ; and since the sum of A's and B's money = $\$9500$, $\frac{9}{10}$ of B's money + B's money, or $\frac{10}{10}$ of B's money, equals $\$9500$; $\frac{1}{10}$ of B's money is $\frac{1}{10}$ of $\$9500$, or $\$950$; and B's money is 10 times $\$950$, or $\$9500$. A's money = $\$9500 - \9500 , or $\$4500$.

54. $\frac{2}{3} + \frac{4}{15} = \frac{7}{15}$; $\frac{1}{20} - \frac{7}{120} = \frac{1}{120}$, the part of the drove that W paid for. R paid for $\frac{2}{3}$ of the drove, and the difference between the part of the drove which R paid for and the part which W paid for, or $\frac{1}{60}$ of the drove, cost $\$56$; hence, the entire drove cost 60 times $\$56$, or $\$3360$. R paid $\frac{2}{3}$ of $\$3360$, or $\$2240$; O paid $\frac{4}{15}$ of $\$3360$, or $\$896$; W paid $\frac{1}{120}$ of $\$3360$, or $\$28$.

55. $(2\frac{2}{3} \times 5\frac{1}{2}) + 7\frac{1}{2} = \frac{113}{6}$; $(3\frac{1}{2} + 4) \div \frac{1}{2} = 15$; $\frac{113}{6} + 15 = 3\frac{79}{6}$.

56. 27 lb. + 29 lb. + 40 lb. = 96 lb., the gross weight ;
 $4\frac{1}{2}$ lb. + $4\frac{3}{8}$ lb. + $7\frac{1}{4}$ lb. = $16\frac{1}{8}$ lb., the weight of the jars ;
 96 lb. - $16\frac{1}{8}$ lb. = $79\frac{7}{8}$ lb., the weight of the butter ;
 $\$28 \div 79\frac{7}{8} = \$\frac{1}{4}\frac{1}{8}$, the price per lb.

57. $\frac{1}{4}$ of what the daughter received = $\$7500$;
 $\frac{1}{2}$ of what the daughter received = $\$5000$;
 What the daughter received = $\$2000$.

Page 141.

58. A owns $\frac{2}{3}$ of the mill, and B owns $\frac{1}{3}$ of it. The difference between their shares is $\frac{1}{3}$. Since $\frac{2}{3}$ of the difference, or $\frac{2}{9}$ of the mill, is valued at $\$8500$, $\frac{1}{9}$ of the value is $\frac{1}{9}$ of $\$8500$, or $\$944\frac{2}{3}$; and the entire value of the mill is 9 times $\$944\frac{2}{3}$, or $\$8500$.

59. $17\frac{1}{2} \times 4\frac{2}{3} = 83\frac{1}{3}$, the number of hundred-weight ;
 $\$18\frac{1}{2} \times 83\frac{1}{3} = \$1558\frac{1}{3}$.

60. A spends $\frac{2}{3}$ of his income, and B spends $1\frac{1}{2}$ times as much, or $\frac{5}{3}$ of his income. Therefore B spends his entire income, and $\frac{1}{3}$ besides, which is \$75. Since \$75 is $\frac{1}{15}$ of his income, the entire income is 15 times \$75, or \$1125.

61. 75 acres @ \$63 per acre = \$4725;
 $\frac{1}{8}$ of 75 acres @ \$71 per acre = \$998 $\frac{7}{8}$;
 $\frac{7}{10}$ of 75 acres @ \$65 per acre = \$1708 $\frac{1}{2}$;
 $\frac{1}{4}$ of 75 acres @ \$66 $\frac{1}{2}$ per acre = \$2306 $\frac{3}{4}$.

The total amount received for the land was \$5011 $\frac{1}{2}$. Subtracting what was paid for it, \$4725, there remains a gain of \$286 $\frac{1}{2}$.

62. 320 $\frac{1}{2}$ lb. @ 15 $\frac{1}{2}$ ¢ = 5049 $\frac{9}{10}$ ¢;
 5049 $\frac{9}{10}$ ¢ + 67 $\frac{1}{2}$ ¢ = 74 $\frac{1}{2}$ ¢, the number of yards.

63. Since he sells $\frac{2}{3}$ of his share, he has left $\frac{1}{3}$ of $\frac{7}{10}$, or $\frac{7}{30}$ of the ship. $\frac{7}{30}$ of \$85,000 is \$14,875, the value of the part of his share that is left.

64. 71 $\frac{1}{2}$ gal. in 11 minutes = 6 $\frac{1}{2}$ gal. per minute;
 113 gal. in 19 minutes = 5 $\frac{1}{2}$ gal. per minute.

Therefore the first spring flows $\frac{1}{2}$ gal. per minute faster.

65. \$1180 = the cost + $\frac{1}{4}$ of the cost, or $\frac{5}{4}$ of the cost. Therefore $\frac{1}{4}$ of the cost is $\frac{1}{5}$ of \$1180, or \$236; and the entire cost is 4 times \$236, or \$944. Selling it for \$1000, he would gain the difference between \$1000 and \$944, or \$56.

66. $3 + 2\frac{1}{2} = 5\frac{1}{2}$; $5\frac{1}{2} - (\frac{1}{2} \times \frac{1}{2}) = 3\frac{1}{2}$;
 $4 + \frac{1}{2} = 6$; $3\frac{1}{2} + 6 = 9\frac{1}{2}$; $9\frac{1}{2} + 4\frac{1}{2} = 2\frac{1}{2}$.

67. Since a man pays a debt of \$1140 and has \$1260 left at the end of 5 years, he saves out of his income \$1140 + \$1260, or \$2400, in 5 years; consequently he saves $\frac{1}{5}$ of \$2400, or \$480, annually; but he saves $\frac{1}{15}$ of his income annually; therefore $\frac{1}{15}$ of his income is \$480; $\frac{1}{15}$ of his income is $\frac{1}{3}$ of \$480, or \$80; and his entire income is 19 times \$80, or \$1520.

Page 142.

68. He owes in all \$3324 $\frac{1}{2}$, and can only pay \$2350, or $\frac{7}{8}$ of what he owes. $\frac{7}{8}$ of \$3360 $\frac{1}{2}$ = \$961 $\frac{1}{8}$, or the sum of money he can pay to the first man; $\frac{1}{4}$ of \$1087 $\frac{1}{2}$ = \$768 $\frac{1}{4}$, or the sum he pays to the second; $\frac{1}{4}$ of \$876 $\frac{1}{2}$ = \$619 $\frac{1}{4}$, the sum he pays to the third creditor.

69. The first cut $3\frac{3}{4}$ cords per day; $3\frac{3}{4} \times 2 = 7\frac{1}{2}$, the number of days the second worked; $19\frac{1}{2} + 7\frac{1}{2} = 26\frac{3}{4}$, the number of days both worked. Since they received \$69, for $26\frac{3}{4}$ days' work, $\$69 \div 26\frac{3}{4} = \$2\frac{1}{2}$, the price per day. Multiplying $\$2\frac{1}{2}$ by the number of days each worked, we find the first received $\$50\frac{1}{2}$, and the second received $\$18\frac{1}{2}$.

70. Since the Northern Pacific Stock was bought at $\$97\frac{1}{2}$ per share and sold at $\$105\frac{1}{2}$, there was a gain of $\$7\frac{1}{2}$ on each share, and the gain on 7 shares was $\$54\frac{1}{2}$. There was also a gain of $\$3\frac{1}{2}$ per share, or $\$52\frac{1}{2}$ on the Union Pacific Stock, making the entire gain $\$106\frac{1}{2}$.

71. Since a bushel of wheat produces 40 lb. of flour, it will require as many bushels to produce 196 lb. as 40 is contained times in 196, or $4\frac{9}{10}$ bu. Since $\frac{1}{2}$ of the wheat was taken for toll, but $\frac{1}{3}$ of it was ground; therefore $\frac{1}{6}$ of the wheat is $4\frac{9}{10}$ bu., or $4\frac{3}{5}$ bu. Hence $\frac{1}{2}$ of the wheat is $\frac{1}{2}$ of $4\frac{3}{5}$ bu., or $2\frac{3}{10}$ bu., and the entire quantity is 8 times $2\frac{3}{10}$ bu., or $16\frac{3}{5}$ bu.

72. $\$365\frac{1}{2} + \frac{1}{2}$ of itself = $\$457\frac{3}{4}$, the selling price so as to gain $\frac{1}{2}$ of the cost. $31\frac{1}{2}$ yd. + $42\frac{1}{2}$ yd. + $47\frac{3}{4}$ yd. = $121\frac{3}{4}$ yd. $\$457\frac{3}{4} \div 121\frac{3}{4} = \$3\frac{7}{8}$, the selling price per yard.

73. $\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$; $\frac{1}{3} - \frac{1}{3} = 0$, the part of estate which the sister received. The difference between the younger brother's share and the sister's share, $\frac{1}{3} - \frac{1}{3} = 0$, of the estate, valued at \$1623. Consequently, the entire value is 65 times \$1623, or \$105,495. $\frac{1}{3}$ of \$105,495 = \$35,165; $\frac{1}{3}$ of \$105,495 = \$35,165; $\frac{1}{3}$ of \$105,495 = \$35,165.

$$74. \quad \frac{2\frac{2}{3}}{2\frac{2}{3}} = \frac{2}{3}; \quad \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}; \quad \frac{2}{3} \text{ times } \frac{2}{3} \times \frac{1}{4} = \frac{1}{3}$$

$$\frac{4\frac{2}{3}}{5\frac{1}{3}} = \frac{2}{3}; \quad \frac{1}{3} + \frac{1}{3} = \frac{2}{3}$$

75. A and B can do $\frac{1}{23\frac{1}{3}}$, or $\frac{1}{70}$ of the work in one day.

A can do $\frac{1}{37\frac{1}{2}}$, or $\frac{1}{75}$ of the work in one day.

$\frac{1}{70} - \frac{1}{75} = \frac{1}{210}$, the part that B can do in one day.

If B could do $\frac{1}{210}$ of the work in one day, he would require 210 days to do the whole; but since he can do $\frac{1}{210}$ per day, he will need but $\frac{1}{210}$ of 210 days, or 1 day, to do the whole work.

Page 143.

76. Since the rate of sailing downstream is $17\frac{1}{2}$ mi. per hr., in 10 hr. the boat could go down 10 times $17\frac{1}{2}$ mi., or 175 mi. Since its rate of coming up is $10\frac{1}{2}$ mi. per hr., it would require as many hours to come up 175 mi. as $10\frac{1}{2}$ mi. is contained times in 175 mi., or $16\frac{1}{2}$ hr.

77. $\$48\frac{1}{2} \div (8 \times 4\frac{1}{2}) = \$1\frac{1}{8}$, the price per day.

78. Since the first man worked $3\frac{1}{2}$ days, or $\frac{7}{2}$ days, and dug 14 rd., in $\frac{1}{2}$ a day he dug $\frac{1}{2}$ of 14 rd., or 2 rd., and in a day he dug 2 times 2 rd., or 4 rd.; therefore, the second man worked 4 days, and they both did $3\frac{1}{2} + 4$, or $7\frac{1}{2}$ days' work; consequently the first earned $\frac{3\frac{1}{2}}{7\frac{1}{2}}$, or $\frac{2}{5}$ of the money, and the second earned $\frac{4}{7\frac{1}{2}}$, or $\frac{8}{15}$ of the money; therefore the first received $\frac{2}{5}$ of \$75, or \$30, and the second received $\frac{8}{15}$ of \$75, or \$40.

79. Since $\frac{1}{3}$ of the property is invested in real estate, $\frac{2}{3}$ of it remains; $\frac{1}{2}$ of $\frac{2}{3} = \frac{1}{3}$, the part of the property invested in bonds, and $\frac{2}{3}$ of it remains; $\frac{1}{4}$ of $\frac{2}{3} = \frac{1}{6}$, the part of the property invested in bank stock, and the remainder, which is $\frac{1}{6}$ of the property, equals \$3500. Since $\frac{1}{6}$ of the property is \$3500, $\frac{1}{3}$ of it is $\frac{1}{2}$ of \$3500, which is \$1750, and the entire property is 105 times \$1750, or \$183,750.

80. $5\frac{3\frac{1}{2}}{7\frac{1}{2}} = 5\frac{7}{15} = 4\frac{2}{3}$; $\frac{49\frac{3}{4}}{11} = 4\frac{11}{16}$ and $\frac{22\frac{1}{2}}{9} = 2\frac{5}{6}$. $4\frac{11}{16} - 2\frac{5}{6} = 1\frac{11}{24}$.

Subtracting $1\frac{11}{24}$ from the sum of the two numbers, $4\frac{2}{3}$, there remains $3\frac{11}{24}$, which is the other number.

81. A and B can do $\frac{1}{2}$ of the work per day; and, since A can do $\frac{1}{3}$ as much as B, when both work together A does 3 parts while B does 4 parts, or A does $\frac{3}{7}$ and B $\frac{4}{7}$ of the work. $\frac{3}{7}$ of $\frac{1}{2}$, or $\frac{3}{14}$, is the part A does per day, therefore it will take him 28 days to do the work; $\frac{4}{7}$ of $\frac{1}{2}$, or $\frac{2}{7}$, of the work is the part B does per day, therefore it will take him 21 days.

82. $\frac{1}{3}$ of the price of the house + ($\frac{1}{3}$ of $\frac{2}{3}$), or what remained, equals $\frac{1}{2}$ of the price. Since $\frac{1}{3}$ of the price = \$5260, $\frac{1}{3}$ of it = $\frac{1}{3}$ of \$5260, or \$1753, and the entire price is 9 times \$1753, which is \$15,777.

83. The supply-pipe will fill the cistern at the rate of 28 gal. per hour, and the discharge-pipe will empty it at the rate of 40 gal. per hour. After the supply-pipe runs 4 hours, there are 112 gal. in the

18 A KEY TO THE STANDARD ARITHMETIC.

cistern. Both pipes being turned on, the cistern will be emptied at the rate of 12 gal. per hour, and it will take as many hours to empty 112 gal. as 12 is contained times in 112, or $9\frac{1}{2}$ hours.

REDUCTION OF DECIMALS.

Page 149.

$$27. \quad .12\frac{1}{2} = \frac{12\frac{1}{2}}{100} = \frac{25}{2} + 100 = \frac{25}{200} = \frac{1}{8}.$$

$$28. \quad .18\frac{3}{4} = \frac{18\frac{3}{4}}{100} = \frac{75}{4} + 100 = \frac{75}{400} = \frac{3}{16}.$$

$$29. \quad .37\frac{1}{2} = \frac{37\frac{1}{2}}{100} = \frac{75}{2} + 100 = \frac{75}{200} = \frac{3}{8}.$$

$$30. \quad .49\frac{1}{8} = \frac{49\frac{1}{8}}{100} = \frac{222}{8} + 100 = \frac{222}{800}.$$

$$31. \quad .62\frac{1}{2} = \frac{62\frac{1}{2}}{100} = \frac{125}{2} + 100 = \frac{125}{200} = \frac{5}{8}.$$

$$32. \quad .41\frac{1}{3} = \frac{41\frac{1}{3}}{100} = \frac{124}{3} + 100 = \frac{124}{300} = \frac{31}{75}.$$

$$33. \quad .24\frac{2}{3} = \frac{24\frac{2}{3}}{100} = \frac{122}{3} + 100 = \frac{122}{300}.$$

$$34. \quad .56\frac{2}{3} = \frac{56\frac{2}{3}}{100} = \frac{241}{3} + 100 = \frac{241}{300}.$$

$$35. \quad .416\frac{2}{3} = \frac{416\frac{2}{3}}{1000} = \frac{1250}{3} + 1000 = \frac{1250}{3000} = \frac{5}{12}.$$

$$36. \quad .008\frac{1}{4} = \frac{3\frac{1}{4}}{1000} = \frac{12}{4} + 1000 = \frac{12}{4000} = \frac{3}{1000}.$$

$$37. \quad .075\frac{2}{5} = \frac{75\frac{2}{5}}{1000} = \frac{762}{5} + 1000 = \frac{762}{5000}.$$

$$38. \quad .648\frac{4}{5} = \frac{648\frac{4}{5}}{1000} = \frac{2212}{5} + 1000 = \frac{2212}{5000}.$$

$$39. \quad .0014\frac{1}{2} = \frac{14\frac{1}{2}}{10000} = \frac{29}{2} + 10,000 = \frac{29}{20000} = \frac{17}{120000}.$$

$$40. \quad .095\frac{5}{8} = \frac{95\frac{5}{8}}{1000} = \frac{765}{8} + 1000 = \frac{765}{8000} = \frac{153}{16000}.$$

Therefore $12.095\frac{5}{8} = 12\frac{153}{16000}.$

$$41. \quad .71\frac{2}{3} = \frac{71\frac{2}{3}}{100} = \frac{212}{3} + 100 = \frac{212}{300} = \frac{53}{75}. \quad \text{Therefore } 22.71\frac{2}{3} = 22\frac{53}{75}.$$

$$42. \quad .87\frac{2}{3} = \frac{87\frac{2}{3}}{100} = \frac{422}{3} + 100 = \frac{422}{300} = \frac{211}{150}. \quad \text{Therefore } 43.87\frac{2}{3} = 43\frac{211}{150}.$$

Page 150.

39. $\frac{1}{2} = .5$; therefore $12\frac{1}{2} = 12.5$.
 40. $\frac{3}{4} = .75$; therefore $18\frac{3}{4} = 18.75$.
 41. $\frac{2}{5} = .6$; therefore $24\frac{2}{5} = 24.6$.
 45. $\frac{1}{4} = .25$; therefore $.45\frac{1}{4} = .4525$.
 46. $\frac{4}{9} = .444 +$; therefore $16.4\frac{4}{9} = 16.4444 +$.
 47. $48.5\frac{3}{10} = 48.5$ and $\frac{3}{10}$ reduced to a decimal, or 48.53 .
 48. $.23\frac{2}{5} = .23$ and $\frac{2}{5}$ reduced to a decimal, or $.23625$.
 49. $60.0\frac{1}{2} = 60.0$ and $\frac{1}{2}$ reduced to a decimal, or 60.08 .
 50. $.0001\frac{3}{4} = .000$ and $\frac{3}{4}$ reduced to a decimal, or $.0001733 +$.
 51. $513.00\frac{2}{3} = 513.00$ and $\frac{2}{3}$ reduced to a decimal, or $513.00666 +$.
 52. $75.000\frac{1}{2} = 75.000$ and $\frac{1}{2}$ reduced to a decimal, or 75.0005 .

ADDITION OF DECIMALS.

Page 152.

22.	300.05	24.	2301.39	26.	2.0005
	2108.004		.3		.043
	.000008		.2749		63.00415
	117707.000045		.013		.0513
	<u>120115.054048</u>		<u>2301.9779</u>		<u>65.09895</u>

SUBTRACTION OF DECIMALS.

Page 154.

30. From 580.0067
 Take 96.000049
 484.006651.
33. \$ 7600.
6735.75
 \$ 1435.75 paid for goods.
35. .69 township.
 .069 township.
.621 township.
- \$ 9875.84
7026.65
 \$ 16902.49 cash and goods on hand.
 \$ 16,902.49 - \$ 14,335.75 = \$ 2566.74, gain.

DIVISION OF DECIMALS.

Page 160.

58. 22.5 bu. of wheat @ 98¢ a bu. = \$22.05 ;
 $\$22.05 + \$9.20 = \$31.25$, what was received for corn ;
 $\$31.25 \div \$.625 = 50$, number of bushels of corn.

REVIEW EXERCISES.

Page 167.

8. $.37\frac{1}{2}$ of 360 acres = 135 acres, A's share ;
 $.62\frac{1}{2}$ of 360 acres = 225 acres, B's share.
9. $.26 + .39 = .65$, the part sold ;
 $1.00 - .65 = .35$, the part unsold ;
 $\therefore .35 = 70$ bu., and $.01 = \frac{1}{3}$ of 70 bu., or 2 bu.
 The whole number of bushels = 100 times 2 bu., or 200 bu.
10. $.00012 \times 12 = .00144$.
11. $12 \div .000012 = 12.000000 \div .000012 = 1,000,000$.
12. $.000012 \div .012 = .001$.
13. 6 cords of wood at \$3.37 $\frac{1}{2}$ = \$20.25 ;
 $\$20.25 \div \$1.12\frac{1}{2} = 18$, the number of days.
14. 35.5 bu. of wheat at 98¢ per bu. = \$34.79 ;
 $\$34.79 + \$17.28 = \$52.07$, what was received for oats ;
 $\$52.07 \div \$.35 = 148\frac{3}{7}$, the number of bushels of oats.
15. 33.68 miles $\div .8 = 42.1$, the number of miles he can travel in one day ;
 42.1 miles $\times 7.5 = 315.75$ miles, the distance he can travel.
16. $\$6220.50 \div 71.5 = \87 , the price per acre.
17. 297560 bricks = 297.560 M. ; and
 $\$7.62\frac{1}{2} \times 297.560 = \2268.895 .
18. 1468000 bricks = 1468 M. ; $\$7.75 \times 1468 = \$11,377$.

Page 168.

19. $5280 \text{ ft.} + 9.18 \text{ ft.} = 578.31 +$.
20. Since he sold .3, there remained unsold .7 of his share; $.7$ of $4725 = .33075$.
21. 3.1416 times $1710 \text{ ft.} = 5372.136 \text{ ft.}$
22. $4.31 \text{ mi.} + 3.92 \text{ mi.} = 8.23 \text{ mi.}$, the distance apart in one hour.
 17 times $8.23 \text{ mi.} = 139.91 \text{ mi.}$, the distance apart in 17 hours.
23. $\frac{4\frac{1}{2}}{18\frac{1}{2}} = \frac{2^1}{9} + \frac{1^1}{2} = \frac{2^1}{9} \times \frac{1}{2} = \frac{1^1}{9^1 \times 2^1} ; \frac{1}{9} + \frac{1}{2} = \frac{7}{6} ;$
 $\frac{1^1}{9^1 \times 2^1} \times \frac{7}{6} = \frac{1^1 \times 7^1}{10^1 \times 9^1}$. Reducing $\frac{1^1 \times 7^1}{10^1 \times 9^1}$ to a decimal, we have $.17899 +$.
24. 15 times $219 \text{ lb.} = 3285 \text{ lb.}$; 3285 lb. at 5% = $\$164.25$. Subtracting what was paid, or $\$125$, there remains a gain of $\$39.25$.
25. 6.75 tons are ten times $.67\frac{1}{2}$ tons. Therefore 6.75 tons are worth 10 times $\$7.50$, or $\$75.00$.
26. 11.350 times $\$1.75 = \$19.86\frac{1}{4}$.
27. $14.6 \text{ A.} + 20.25 \text{ A.} + 27.625 \text{ A.} = 62.475 \text{ A.}$
 $62.475 \text{ A.} @ \$57.60 = \3598.56 .
28. $183.26 \text{ A.} + 412.625 \text{ A.} + 640 \text{ A.} + 150.875 \text{ A.} + 240.5 \text{ A.}$
 $+ 61.971 \text{ A.} = 1689.231 \text{ A.}$;
 $2735 \text{ A.} - 1689.231 \text{ A.} = 1045.769 \text{ A.}$, the land unsold.
29. 150 barrels @ $\$1.87\frac{1}{2}$ per barrel = $\$281.25$, the cost.
 $.7$ of 150 barrels, or 105 barrels @ $\$1.95$ per barrel = $\$204.75$;
 $.3$ of 150 barrels, or 45 barrels @ $\$1.80$ per barrel = $\$81.00$;
 $(\$204.75 + \$81.00) - \$281.25 = \4.50 , the gain.

Page 169.

30. $(29.0345 \text{ rods} + 22.3265 \text{ rods}) \times 2 = 102.722 \text{ rods.}$
31. $\$5.25 \times 326 = \1711.50 , the cost of the flour ;
 $\$1711.50 + \$12 = \$1723.50$, the selling price to gain $\$12$;
 $\$4.87\frac{1}{2} \times 58 = \282.75 , the amount received for first lot ;

22 A KEY TO THE STANDARD ARITHMETIC.

\$1723.50 - \$282.75 = \$1440.75, what must be received for remainder.

326 bbl. - 58 bbl. = 268 bbl., the quantity unsold ;

\$1440.75 ÷ 268 = \$5.375+, selling price per bbl. for remainder.

32. $\frac{2\frac{3}{4}}{4\frac{3}{4}} = \frac{1\frac{1}{4}}{2\frac{1}{4}} + \frac{1\frac{1}{4}}{2\frac{1}{4}} = \frac{3\frac{1}{4}}{4\frac{3}{4}}$; $\frac{3\frac{1}{4}}{4\frac{3}{4}} = \frac{1\frac{0}{4}}{1\frac{7}{4}} + \frac{1\frac{7}{4}}{1\frac{7}{4}} = \frac{4\frac{0}{4}}{4\frac{3}{4}}$; $\frac{3\frac{1}{4}}{4\frac{3}{4}} + \frac{4\frac{0}{4}}{4\frac{3}{4}} = \frac{1\frac{1\frac{1}{4}}{4\frac{3}{4}}}{4\frac{3}{4}}$;
 $\frac{1\frac{1\frac{1}{4}}{4\frac{3}{4}}}{4\frac{3}{4}} \times \frac{8}{8} = \frac{1\frac{1\frac{1}{4}}{4\frac{3}{4}}}{4\frac{3}{4}}$. $\frac{1\frac{1\frac{1}{4}}{4\frac{3}{4}}}{4\frac{3}{4}} = .667857+$, and adding .01 = .677857+.

33. $\frac{3.5}{12\frac{3}{4}} = 3\frac{1}{2} + 12\frac{3}{4} = \frac{6\frac{3}{4}}{2\frac{3}{4}}$; $(6\frac{3}{4} - 4\frac{1}{4}) \div (\frac{1}{2} \times 4\frac{5}{8}) = 1$;
 $\frac{6\frac{3}{4}}{2\frac{3}{4}} \div 1 = \frac{6\frac{3}{4}}{2\frac{3}{4}}$; $\frac{6\frac{3}{4}}{4\frac{5}{8}} = \frac{3\frac{1\frac{5}{8}}{8}}{4\frac{5}{8}} = .05903+$.

34. $13\frac{1}{2}$ cd. + $15\frac{3}{4}$ cd. + $18\frac{1}{4}$ cd. + $21\frac{1}{2}$ cd. = $69\frac{1}{2}$ cords ;
 $69\frac{1}{2}$ cords @ \$4.25 = \$293.78 $\frac{1}{2}$.

35. \$11,578.40 × 23 = \$266,303.20
 13,357.82 × 12 = 160,293.84
 19,125.26 × 12.95 = 247,672.117

\$674,269.157

\$674,269.15 ÷ 47.95 = \$14,061.921+, the average cost per mile.

36. 15 men's work for 39 days at \$2.10 per day = \$1228.50 ; the cost of material was \$2150.65 ; the total expense to contractor was \$1228.50 + \$2150.65, or \$3379.15. \$3575 - \$3379.15 = \$195.85, the gain.

37. $(12 - .6) \div 2 = 5.7$; $(16 - .8) \div 4 = 3.8$; $5.7 + 3.8 = 9.5$;
 $9.5 - \frac{1}{2} = 9$, or $8.5 = 1$; $1 \div 18.75 = .053\frac{1}{3}$.

38. Mr. H. D. NOBLE

Bought of HENRY DARON & Co.

9 pr. calf boots @ \$4.25 a pr.	\$38	25
7 pr. kip boots @ \$3.15 a pr.	22	05
12 pr. kid shoes @ \$2.65 a pr.	31	80
8 pr. cloth shoes @ \$2.25 a pr.	18	00
Received payment,	\$110	10

HENRY DARON & Co.

39. Mrs. B. D. Ross

Bought of Cook & Co.

14 yd. silk @ \$1.37½ a yd.	\$ 19	25
45 yd. sheeting @ 7¢ a yd.	3	15
9 handkerchiefs @ 25¢.	2	25
3 pr. kid gloves @ \$1.12½ a pair	3	375
5 neckties @ 50¢ each	2	50
Received payment,	\$ 30	525

Cook & Co.

Per Gibbs.

REVIEW EXERCISES.

Page 198.

35. 5 cwt. 24 lb. = 524 lb.; 524 lb. 4 oz. = 524½ lb.;

524½ lb. × 8 = 4194 lb., the entire quantity;

4194 lb. @ 4½¢ = \$ 188.73.

36. 2 gal. 3 qt. 1½ pt. = 23½ pt. Since each cup holds but half of a pint, there must be twice as many cups as pints, or 47 cups.

37. 3 T. 4 cwt. 20 lb. = 6420 lb. Dividing 6420 by 60, the number of pounds in a bushel of wheat, there are 107 bu., and since each bag holds 2 bu., there are ½ as many bags as bushels, or 53½ bags.

38. There are 7000 grains in a pound of lead, and 5760 grains in a pound of gold. Subtracting, we find a pound of lead to be 1240 grains heavier than a pound of gold.

39. There are 480 grains in one ounce of silver, and 437½ grains in one ounce of feathers. Therefore 1 oz. of silver is 42½ grains heavier.

40. There are 7000 grains in a pound Avoirdupois; 115 times 7000 grains = 805,000 grains, the weight of the block in grains. Since there are 5760 grains in a pound Troy, 805,000 ÷ 5760 = 139 lb. 9 oz. 1 pwt. 16 gr. the weight in Troy weight.

41. Since there are 5280 ft. in a mile, and the railroad is 5 miles long, and 2 lines of rail are required, the length in feet is 5 times 5280 ft. × 2, or 52,800 ft. Since the rails are 30 ft. long, as many rails will be required as 30 ft. is contained times in 52,800 ft., or 1760 rails.

42. 6 hr. = 21,600 sec.; 10 min. 15 sec. = 615 sec.

21,600 sec. ÷ 615 sec. = 35¼, the number of miles per hour.

24 A KEY TO THE STANDARD ARITHMETIC.

43. $230 \times 180 = 41,400$ sq. rd. ;
 $41,400$ sq. rd. $\div 160 = 258\frac{3}{4}$, the number of acres.
 $\$75 \times 258\frac{3}{4} = \$19,406.25$, the value of the farm.

44. $\frac{7}{8}$ mi. = 280 rd.
 $\frac{1}{4}$ rd. = 1 yd. 2 ft. 6 in.
 $\frac{5}{8}$ ft. = 10 in.
 Sum = 280 rd. 2 yd. 0 ft. 4 in.

45. $\frac{3}{4}$ of 6 rd. 3 yd. 2 in. = $865\frac{1}{2}$ in. ; 1 mi. = 63,360 in.
 $865\frac{1}{2}$ in. = $\frac{865\frac{1}{2}}{63360}$, or $\frac{5\frac{1}{2}}{4320}$ of a mile.

46. 35 sovereigns = 700 shillings
 27 half sovereigns = 270 shillings
 13 crowns = 65 shillings
 41 half crowns = $102\frac{1}{2}$ shillings
 1 guinea = 21 shillings
1 shilling

Sum = $1159\frac{1}{2}$ shillings

$\$.243325 \times 1159\frac{1}{2} = \282.135 , the value in U. S. money.

47. 110 bu. 3 pk. 5 qt. = 110.90625 bu.
 4 bu. 1 pk. 1 qt. = 4.28125 bu.

Since 4.28125 bu. produced 110.90625 bu., 1 bu. of seed produced as many bushels as 4.28125 is contained times in 110.90625, or $25\frac{1}{3}\frac{1}{3}$ bu., or 25 bu. 3 pk. 4 qt. 1.92 + pt.

48. 3 T. 6 cwt. 27 lb. = 3.3135 T. ; $\$4.75 \times 3.3135 = \$15.739+$.

49. $\$1675 \div 7\frac{1}{2} = \$223\frac{1}{3}$, profits of one month.
 $\$223\frac{1}{3} \times 12 = \2680 , profits of a year.

Page 199.

50. 1 hr. 35 min. = $1\frac{7}{12}$ hr. ; 90 mi. $\div 1\frac{7}{12} = 56\frac{1}{3}$ mi., the rate per hour.

51. 2000 lb. $\div 57\frac{3}{4}$ lb. = $34.858+$, the number of cubic feet.

52. 77° 2' 48" longitude of Washington.
 73 44 53 longitude of Albany.

 3° 17' 55" difference in longitude.

53. $2^{\circ} 20' 22''$ east, longitude of Paris.
 $74 \quad \quad \quad 3$ west, longitude of New York.

Adding, $76^{\circ} 20' 25''$ is the difference of longitude.

54. $2(18 \text{ rd.} + 23 \text{ rd.}) = 84 \text{ rd.}$; $16\frac{1}{2} \text{ ft.} \times 84 = 1386 \text{ ft.}$, the distance around the field. $\$.18\frac{1}{2} \times 1386 = \$259.87\frac{1}{2}$, the cost of fencing.

55. $3 \text{ bu. } 1 \text{ pk. } 3 \text{ qt.} = 107 \text{ qt.}$; $5 \text{ A. } 96 \text{ sq. rd.} = 5.6 \text{ A.}$ Since 107 qt. will fertilize 1 acre, it will require 5.6 times as much to fertilize 5.6 A.; $107 \text{ qt.} \times 5.6 = 599.2 \text{ qt.}$ $599.2 \text{ qt.} = 18 \text{ bu. } 2 \text{ pk. } 7\frac{1}{2} \text{ qt.}$

56. $60 \text{ A. } 130 \text{ sq. rd.} = 9730 \text{ sq. rd.}$, or 608.125 sq. ch. Dividing the area of field by the width we have the length, which is $30.03 + \text{ch.}$

57. $1,000,000 \div 100 = 10,000$, the number of minutes it will take;
 $10,000 \div (60 \times .10) = 16\frac{2}{3}$, the number of days it will require.

58. $5 \text{ reams } 15 \text{ quires } 20 \text{ sheets} = 5.7916\frac{2}{3} \text{ reams}$;
 $\$3.60 \times 5.7916\frac{2}{3} = \20.85 , the cost of the paper.

59. $3\frac{1}{2} \text{ tons @ } \$6.50 \text{ per ton} = \$21.125$, the cost of the coal;
 $\$21.125 \div \$4.75 = 4.447 +$ the number of barrels of flour.

60. $9\frac{1}{2} \text{ oz. @ } 40\text{¢ an oz.} = \3.90 , the cost.
 $437\frac{1}{2} \text{ gr.} \times 9\frac{1}{2} = 4265.625 \text{ grains purchased.}$
 $4265.625 \text{ gr.} + 480 \text{ gr.} = 8.886$, the number of ounces, Troy weight.
 $8.886 \text{ oz. @ } 60\text{¢ per oz.} = \5.33 , the selling price.
 $\$5.33 - \$3.90 = \$1.43$, the gain.

61. $6 \text{ lb. } 4 \text{ oz. } 10 \text{ pwt.}$, or $1630 \text{ pwt.} \div 2 \text{ oz. } 5 \text{ pwt.}$, or $45 \text{ pwt.} = 34$, the number of spoons.

62. $6 \text{ reams } 15 \text{ quires } 20 \text{ sheets} = 3260 \text{ sheets.}$ Each sheet will make 4 posters, or there will be 13,040 posters. $13,040 \text{ posters @ } \$5.75 \text{ per M.} = \$74.98$.

Page 200.

63. There are 21 nights in three weeks; therefore I will burn 21 pt., or $2\frac{1}{2} \text{ gal. of oil.}$ $2\frac{1}{2} \text{ gal. @ } 15\text{¢ per gal.} = 39\frac{3}{4} \text{¢}$.

64. $\$.193 \times 1000 = \193 , value of 1000 francs.

65. Oil at $10\text{¢ a pint} = 80\text{¢ a gallon}$, hence the gain on one gallon was 15¢ ; $3 \text{ bbl. of } 31\frac{1}{2} \text{ gal. each} = 94\frac{1}{2} \text{ gal.}$; $94\frac{1}{2} \text{ gal. sold at a gain of } 15\text{¢} = \$14.17\frac{1}{2} \text{ gain.}$

66. £ 175 10s. 6d. = £ 175.525 ;

£ 175.525 ÷ 5 = £ 35.105, the cost of one horse.

£ 35.105 × 12 = £ 421.26, the cost of 12 horses.

£ 4.8665 × 421.26 = \$ 2050.06, the entire cost.

67. 220 qt. @ 6¢ = \$ 13.20. Each quart lacked $\frac{1}{2}$ of a gill of being full ; therefore in 220 quarts there was a lack of 44 gills, or $5\frac{1}{2}$ quarts. $5\frac{1}{2}$ qt. @ 6¢ = 33¢. The actual worth was 33¢ less than \$ 13.20, or \$ 12.87.

68. $\frac{1}{2}$ of an ounce apothecaries' weight = 120 grains.

120 grains ÷ 6 = 20, the number of powders.

69. 7 dr. 2 sc. = 23 scruples, or 460 grains.

460 gr. ÷ 5 = 92, the number of pills.

70. 5 times 2 cwt. 10 lb. 12 oz. = 1053 $\frac{1}{2}$ lb., what he should have sold ; but since he gave only 15 $\frac{1}{2}$ oz., or $\frac{3}{4}$ lb., for a pound, he was paid for as many pounds as $\frac{3}{4}$ is contained times in 1053 $\frac{1}{2}$ lb., or 1070 $\frac{1}{4}$ lb. (1070 $\frac{1}{4}$ lb. - 1053 $\frac{1}{2}$ lb.) × \$.05 = \$.83 $\frac{3}{4}$, the amount defrauded.

71. 8 bu. 3 pk. 4 qt. = 8.875 bu. ;

8.875 bu. @ \$ 3 $\frac{1}{2}$ per bu. = \$ 31.062 $\frac{1}{2}$;

\$ 31.06 + \$.03 $\frac{1}{2}$ = 887.5, the number of pounds flour.

887.5 lb. + 196 lb. = 4.528 + the number of bbl.

72. 54 cwt. 85 lb. = 5485 lb. at 4¢ per lb. = \$ 219.40.

$\frac{1}{2}$ of 5485 lb. @ 5¢ per lb. = \$ 137.125

$\frac{1}{4}$ of 5485 lb. @ 5 $\frac{1}{2}$ ¢ per lb. = 100.558 $\frac{1}{4}$

$\frac{1}{4}$ of 5485 lb. @ 4¢ per lb. = 36.566 $\frac{1}{4}$

He received for the sugar, \$ 274.25.

\$ 274.25, the selling price - \$ 219.40, the cost = \$ 54.85, the gain.

73. 8 lb. 4 oz. = 8 $\frac{1}{2}$ lb. ; 7000 gr. × 8 $\frac{1}{2}$ = 57,750 grains ;

57,750 gr. ÷ 412 $\frac{1}{2}$ gr. = 140, the number of coins.

74. 116 bu. 1 pk. 4 qt. = 3724 qt. ;

2 bu. 1 pk. 4 qt. = 76 qt. ;

3724 qt. + 76 qt. = 49, the number of bags.

LONGITUDE AND TIME.

Page 202.

2. $15 \overline{)46^{\circ} \quad 15' \quad 30''}$
 3 hr. 5 min. 2 sec., the difference in time.
3. $15 \overline{)77^{\circ} \quad 2' \quad 48''}$
 5 hr. 8 min. $11\frac{1}{3}$ sec., the difference in time.

Page 203.

4. $\begin{array}{r} 87^{\circ} \quad 38' \quad '' \\ 74 \quad 0 \quad 3 \\ \hline 15 \overline{)13 \quad 37 \quad 57} \end{array}$, the difference in longitude.
 0 hr. 54 min. $31\frac{1}{3}$ sec., the difference in time.
5. $\begin{array}{r} 122^{\circ} \quad 26' \quad 15'' \\ 75 \quad 10 \\ \hline 15 \overline{)47 \quad 16 \quad 15} \end{array}$, the difference in longitude.
 3 hr. 9 min. 5 sec., the difference in time.

When it is noon at Philadelphia it will be before noon at all places west. Therefore the time at San Francisco will be 12 hr. — 3 hr. 9 min. 5 sec., or 50 min. 55 sec. after 8 o'clock.

6. $15 \overline{)5^{\circ} \quad 59' \quad 18''}$
 23 min. $57\frac{1}{3}$ sec., the difference in time.

Washington being west of Boston, the time will be earlier, or 23 min. $57\frac{1}{3}$ sec. before twelve.

7. $\begin{array}{r} 93^{\circ} \quad 4' \quad 55'' \\ 73 \quad 44 \quad 53 \\ \hline 15 \overline{)19 \quad 20 \quad 2} \end{array}$, the difference in longitude.
 1 hr. 17 min. $20\frac{2}{3}$ sec. earlier.
8. $\begin{array}{r} 13^{\circ} \quad 23' \quad 43'' \text{ east.} \\ 84^{\circ} \quad 26' \quad \text{west.} \\ \hline 15 \overline{)97^{\circ} \quad 49' \quad 43''} \end{array}$, the difference in longitude.
 6 hr. 31 min. $18\frac{1}{3}$ sec., the difference in time.

Since Berlin is east from Greenwich and Cincinnati is west, their difference in longitude is the sum of $13^{\circ} 23' 43''$ and $84^{\circ} 26'$, and the difference in time is $\frac{1}{15}$ of that sum.

$$9. \quad 15 \overline{) 2^{\circ} \quad 20' \quad 22''}$$

9 min. $21\frac{2}{3}$ sec., the difference in time.

Since he travels east, his watch will be 9 min. $21\frac{2}{3}$ sec. slow.

$$10. \quad 116^{\circ} \quad 27' \quad 30'' \text{ east.}$$

77

$$15 \overline{) 193 \quad 27 \quad 30} \text{ the west.}$$

12 hr. 53 min. 50 sec., the difference in time.

The difference in longitude between the places, one being east and the other west of the given meridian, is found by adding, and since Pekin is east from Washington, the time at Pekin will be 12 hr. 53 min. 50 sec. past midnight, or 53 min. 50 sec. past noon, January 1st.

Page 204.

2. Since the difference in time is 3 hr. 16 min. 23 sec., the difference in longitude will be 15 times as many degrees, etc., or $49^{\circ} 5' 45''$.

3. Since the difference in time is 1 hr. 16 min. 14 sec., the difference in longitude will be 15 times as many degrees, etc., or $19^{\circ} 3' 30''$.

4. 1 hr. 2 min. 20 sec., the difference in time.

15

$$15^{\circ} \quad 35' \quad \underline{\hspace{1cm}}, \quad \text{the difference in degrees.}$$

5. The difference in time is 1 hr. 30 min., and the difference in longitude is 15 times as many degrees, etc., or $22^{\circ} 30'$.

6. 43 min. 32 sec., the difference in time.

15

$$10^{\circ} \quad 53' \quad 0'', \text{ the difference in longitude.}$$

7. 4 hr. 55 min. $37\frac{1}{2}$ sec.

15

$$73^{\circ} \quad 54' \quad 25'', \text{ the difference in longitude.}$$

8. 2 hr. 58 min. 13 sec., the difference in time.

15

$$44^{\circ} \quad 33' \quad 15'', \text{ the difference in longitude.}$$

Since San Francisco is west from Rochester, and, therefore, farther west from Greenwich, we add the difference in longitude to the longitude of Rochester, and the sum is the longitude of San Francisco.

$$44^{\circ} \quad 33' \quad 15''$$

$$77^{\circ} \quad 51'$$

$$\hline 122^{\circ} \quad 24' \quad 15''$$

9. The difference in time between Greenwich and Harrisburg is 5 hr. 7 min. 20 sec.; multiplying by 15 the product is $76^{\circ} 50'$, the difference in longitude, and since we reckon longitude from Greenwich, Harrisburg is in $76^{\circ} 50'$ west longitude.

10. 15 times the difference in time gives $23^{\circ} 45'$ the difference in longitude, and since his time was too slow, he must have been traveling toward the east.

11. The difference in time is 5 hr. 10 min. Hence the difference in longitude is $77^{\circ} 30'$; Paris being east from Philadelphia, the longitude is found to be $2^{\circ} 20'$ east from Greenwich.

PRACTICAL MEASUREMENTS.

Page 206.

9. $43 \times 26 = 1118$ sq. ft., one side of the roof;
 1118 sq. ft. $\times 2 = 2236$ sq. ft., both sides.
10. $18 \times 8 = 144$ sq. rods $= \frac{1}{16} A = \frac{1}{16}$ acre.
11. $\$342.50 \times .9 = \308.25 , value of lot.
12. $20 \times 20 = 400$ sq. ch.; 400 sq. ch. = 40 acres.
13. $160 \times 120 = 19200$ sq. rd.; 19200 sq. rd. = 120 acres.
14. $40 \times 35 = 1400$ sq. ch. = 140 acres; $\$85 \times 140 = \$11,900$.
15. Area divided by length equals width;
 $840 \div 35 = 24$, the width in yards.
16. 160 sq. rd. $\times 8 = 1280$ sq. rd., area;
 $1280 \div 32 = 40$, the number of rods in length.
17. $2520 \div 144 = 17\frac{1}{2}$ sq. ft., area;
 $17\frac{1}{2} \div 3\frac{1}{2} = 5$, the number of feet in length.
18. $80\frac{1}{2}$ ft. = $26\frac{1}{3}$ yd.; $1610 \div 26\frac{1}{3} = 60$, the number of yards deep.
19. 100 acres = $16,000$ sq. rd., area;
 $16000 \div 80 = 200$, the number of rods in length.

Page 207.

9. $1628 \div 74 = 22$, the altitude in feet.
10. $3404 \div 37 = 92$, the length in feet.
11. $160 \div 12 = 13\frac{1}{3}$, the length in rods.
12. $160 \times 3\frac{1}{2} = 560$ sq. rd., area; $560 \div 80 = 7$, the width in rods.
13. $160 \times 132 = 21,120$ sq. rd., area;
 $21,120 \div 132 = 160$, the length in rods.

Page 208.

7. $615 \text{ ft.} = 205 \text{ yd.}$; $\frac{205 \times 360}{2} = 36,900 \text{ sq. yd., area of triangle}$;
 $36,900 + 4840 = 7\frac{1}{4}\frac{1}{4}$, the number of acres.
8. $\frac{1}{2}(18.36 \times 10.54) = 96.7572 \text{ sq. ch., area of triangle}$;
 $96.7572 \div 10 = 9.67572$, the number of acres;
 $\$70 \times 9.67572 = \677.30 , the cost.
9. $\frac{1}{2}(13 \times 28) = 182$, the number of sq. ft. in one gable;
 $182 \text{ sq. ft.} \times 2 = 364 \text{ sq. ft., the area.}$

Page 209.

6. $\frac{42 + 50}{2} = 46$; $46 \times 32 = 1472 \text{ sq. rd., area}$; $1472 + 160 = 9\frac{1}{2} \text{ A.}$
7. $\frac{52 + 58}{2} = 55$; $55 \times 40 = 2200 \text{ sq. rd., area}$;
 $2200 \text{ sq. rd.} = 13\frac{1}{4} \text{ A.}$
8. $\frac{64 + 76}{2} = 70$; $70 \text{ ch.} = 280 \text{ rd.}$; $280 \times 192 = 53,760 \text{ sq. rd.}$;
 $53,760 + 160 = 336 \text{ A., the area of farm.}$
9. $\frac{96 + 108}{2} = 102$; $102 \times 180 = 18,360 \text{ sq. rd.}$; $18,360 \text{ sq. rd.} = 114\frac{1}{4} \text{ A.}$
10. $\frac{38 + 28}{2} = 33$; $33 \times 25 = 825 \text{ sq. ch.}$; $825 \text{ sq. ch.} = 82\frac{1}{2} \text{ A.}$
11. $\frac{8 + 5}{2} = 4 \text{ ft.}$; $4 \times 20 = 80 \text{ sq. ft., area of walk.}$

Page 211.

6. $869 + 3.1416 = 276.61064 \text{ rd., diameter}$;
 $\frac{1}{2}$ of $276.61064 \text{ rd.} = 69.15266 \text{ rd., half of radius}$;
 $869 \times 69.15266 = 60098.66 \text{ sq. rd., area.}$
7. $728 + 3.1416 = 231.72905 \text{ rd., diameter}$;
 $\frac{1}{2}$ of $231.72905 \text{ rd.} = 57.93226 \text{ rd., half of radius}$;
 $728 \times 57.93226 = 42174.68 \text{ sq. rd., area.}$
8. $240 \times 3.1416 = 753.984 \text{ rd., circumference}$;
 $\frac{1}{4}$ of $240 \text{ rd.} = 60 \text{ rd., half of radius}$;
 $753.984 \times 60 = 45239.04 \text{ sq. rd., area.}$

9. $125 \text{ rd.} \times 3.1416 = 392.7 \text{ rd.}$, the circumference ;
 $392.7 \times 1\frac{1}{2} = 12271.875 \text{ sq. rd.}$, area.
10. $364 \text{ rd.} \times 3.1416 = 1143.5424 \text{ rd.}$, the circumference ;
 $1143.5424 \times 2\frac{1}{4} = 104062.3584 \text{ sq. rd.}$, area.
11. $320 \text{ rd.} \times \frac{101.856}{4} = 8148.48 \text{ sq. rd.}$, area.
12. $436 \text{ rd.} + 3.1416 = 138.7827 \text{ rd.}$, the diameter ;
 $436 \times \frac{138.7827}{4} + 160 = 94.5457 \text{ A.}$

PLASTERING AND DECORATING.

Page 212.

1. $18 \times 12 = 216 \text{ sq. ft.}$, the area of one side ;
 $216 \times 2 = 432 \text{ sq. ft.}$, the area of the two equal sides ;
 $16 \times 12 = 192 \text{ sq. ft.}$, the area of one end ;
 $192 \times 2 = 384 \text{ sq. ft.}$, the area of both ends ;
 $18 \times 16 = 288 \text{ sq. ft.}$, the area of ceiling ;
 $1104 \text{ sq. ft.} = \text{area of walls and ceiling ;}$
 $1104 + 9 = 122\frac{1}{2} \text{ sq. yd. ; } \$.35 \times 122\frac{1}{2} = \$ 42.93, \text{ cost.}$
2. $(15 + 11) \times 2 = 52 \text{ ft.}$, the distance around the room ;
 $52 \times 10 = 520 \text{ sq. ft.}$, the area of the walls without deductions ;
 $15 \times 11 = 165 \text{ sq. ft.}$, the area of the ceiling ;
 $520 \text{ sq. ft.} + 165 \text{ sq. ft.} = 685 \text{ sq. ft.}$, the area of walls and ceiling ;
 Deductions : —
- | | |
|---|-----------------------------------|
| Base-board, 43 ft. by 9 in. | = $32\frac{1}{2} \text{ sq. ft.}$ |
| $\frac{1}{2}$ the area of a door 6 ft. by 8 ft. | = 24 sq. ft. |
| $\frac{1}{2}$ the area of a door 3 ft. by 7 ft. | = $10\frac{1}{2} \text{ sq. ft.}$ |
| $\frac{1}{2}$ the area of 2 windows $3\frac{1}{2}$ by 8 ft. | = 28 sq. ft. |
| Total deductions | = $94\frac{1}{2} \text{ sq. ft.}$ |
- $685 \text{ sq. ft.} - 94\frac{1}{2} \text{ sq. ft.} = 590\frac{1}{2} \text{ sq. ft.}$, the area to plaster ;
 $590\frac{1}{2} + 9 = 65\frac{1}{2} \text{ sq. yd. ; } \$.30 \times 65\frac{1}{2} = \$ 19.67\frac{1}{2}, \text{ the cost.}$

32 A KEY TO THE STANDARD ARITHMETIC.

3. $(15 + 16\frac{1}{2}) \times 2 = 63$ ft., the distance around the room ;
 $63 \times 10 = 630$ sq. ft., the area of the walls without deductions ;
 $15 \times 16\frac{1}{2} = 247\frac{1}{2}$ sq. ft., the area of the ceiling ;
 630 sq. ft. + $247\frac{1}{2}$ sq. ft. = $877\frac{1}{2}$ sq. ft., the area of the walls and ceiling.

Deductions : —

The base-board, 54 ft. by 9 in. = $40\frac{1}{2}$ sq. ft.

The area of a door 6 ft. by 8 ft. = 48 sq. ft.

The area of a door 3 ft. by 7 ft. = 21 sq. ft.

The area of 3 windows, 3 ft. by 6 ft. = 54 sq. ft.

Total deductions = $163\frac{1}{2}$ sq. ft.

$877\frac{1}{2}$ sq. ft. - $163\frac{1}{2}$ sq. ft. = 714 sq. ft., the area to plaster ;

$714 \div 9 = 79\frac{1}{3}$ sq. yd. ; $\$.35 \times 79\frac{1}{3} = \27.77 , the cost.

4. $(15 + 12\frac{1}{2}) \times 2 = 55$ ft., the distance around the room ;
 $55 \times 10 = 550$ sq. ft., the area of the walls without deductions ;
 $12\frac{1}{2} \times 15 = 187\frac{1}{2}$ sq. ft., the area of the ceiling ;
 550 sq. ft. + $187\frac{1}{2}$ sq. ft. = $737\frac{1}{2}$ sq. ft., the area of the walls and ceiling.

Deductions : —

The base-board, 46 ft. by 9 in. = $34\frac{1}{2}$ sq. ft.

$\frac{1}{2}$ the area of a door 6 ft. by 8 ft. = 24 sq. ft.

$\frac{1}{2}$ the area of a door 3 ft. by 7 ft. = $10\frac{1}{2}$ sq. ft.

$\frac{1}{2}$ the area of 2 windows, 3 ft. by 6 ft. = 18 sq. ft.

Total deductions = 87 sq. ft.

$737\frac{1}{2}$ sq. ft. - 87 sq. ft. = $650\frac{1}{2}$ sq. ft., area to plaster ;

$650\frac{1}{2} \div 9 = 72\frac{5}{18}$ sq. yd. ; $\$.30 \times 72\frac{5}{18} = \21.68 , the cost.

5. $(15 + 15) \times 2 = 60$ ft., the distance around the room ;
 $60 \times 10 = 600$ sq. ft., the area of the walls without deductions ;
 $15 \times 15 = 225$ sq. ft., the area of the ceiling ;
 600 sq. ft. + 225 sq. ft. = 825 sq. ft., the area of the walls and ceiling.

Deductions: —

The base-board, 51 ft. by 9 in.	=	$38\frac{1}{2}$ sq. ft.
$\frac{1}{2}$ the area of a door 6 ft. by 8 ft.	=	24 sq. ft.
$\frac{1}{2}$ the area of a door 3 ft. by 7 ft.	=	$10\frac{1}{2}$ sq. ft.
$\frac{1}{2}$ the area of 2 windows, $3\frac{1}{2}$ ft. by 8 ft.	=	28 sq. ft.
$\frac{1}{2}$ the area of a window 3 ft. by 6 ft.	=	9 sq. ft.
Total deductions	=	<u>$109\frac{1}{2}$ sq. ft.</u>

825 sq. ft. — $109\frac{1}{2}$ sq. ft. = $715\frac{1}{2}$ sq. ft., the area to plaster;

$715\frac{1}{2} \div 9 = 79\frac{1}{2}$ sq. yd.; $\$.30 \times 79\frac{1}{2} = \23.84 , the cost.

6. The ceiling of the parlor contains 225 sq. ft.; of the library $187\frac{1}{2}$ sq. ft.; of the sitting-room $247\frac{1}{2}$ sq. ft.; of the reception-room 165 sq. ft.; of the hall 168 sq. ft.; and the area of all is 993 sq. ft. $993 \div 9 = 110\frac{1}{3}$ sq. yd., area of ceilings; $\$.08 \times 110\frac{1}{3} = \$8.82\frac{2}{3}$, the cost of-kalsomining.

7. Total area of outside of house = 3550 sq. ft.;

Front door, $42\frac{1}{2}$ sq. ft.; back door, 21 sq. ft.;

Front windows above and below, 224 sq. ft.;

Other windows above and below, 216 sq. ft.;

Total deductions, $503\frac{1}{2}$ sq. ft.;

3550 sq. ft. — $503\frac{1}{2}$ sq. ft. = $3046\frac{1}{2}$ sq. ft., or

$338\frac{1}{2}$ sq. yd. to be painted two coats @ $8\frac{1}{2}\phi$ per sq. yd.;

$\$.08\frac{1}{2} \times 338\frac{1}{2} \times 2 = \$57.54\frac{1}{2}$, the cost.

CARPETING.

Page 213.

1. The room being 18 ft. wide and the carpet 3 ft. wide, 6 strips will be required; each strip is 36 ft., or 12 yards, long; therefore 12×6 , or 72 yards, will cover the floor. $\$.85 \times 72 = \61.20 , the cost.

2. Since the floor contains 72 sq. yd.,

$10\phi \times 72 = \$7.20$, the cost of paper lining;

72 yd. carpet @ 5ϕ per yd. for laying = $\$3.60$;

$\$61.20 + \$7.20 + \$3.60 = \72 , the total cost.

34 A KEY TO THE STANDARD ARITHMETIC.

3. Since the width of the room is 17 ft., 6 strips will be required, although a portion of it must be turned under or cut off. Each strip being 8 yards long, 48 yd. will be required.

4. Carpet, 48 yd. @ \$1.75 per yd. = \$84.00.

Lining, $45\frac{1}{2}$ sq. yd. at 9¢ = 4.08.

Total, \$88.08.

5. $13\frac{1}{2} + 2\frac{1}{2} = 6$, the number of strips required ;

6 strips, each 5 yd long = 30 yd. ;

\$1.60 \times 30 = \$48, the cost when strips run lengthwise.

15 ft. $+ 2\frac{1}{2} = 6\frac{3}{4}$. Therefore 7 strips will be required.

7 strips, each $13\frac{1}{2}$ ft. long = $31\frac{1}{2}$ yd.

\$1.60 \times $31\frac{1}{2} = 50.40 , the cost when strips run across the room.

6. Since the room is 16 ft. wide, and the carpeting $2\frac{1}{2}$ ft. wide, 8 strips will be required ; and since the room is 6 yd. long, and there is a waste of $\frac{1}{2}$ of a yd. in each strip, each strip must be $6\frac{1}{2}$ yd. long. $6\frac{1}{2} \times 8 = 49\frac{1}{2}$ yd. \$1.85 \times $49\frac{1}{2} = 91.76 , the cost.

7. $13\frac{1}{2}$ ft. $+ 2\frac{1}{2}$ ft. = 6, the number of strips ;

$19\frac{1}{2}$ ft. $+ 3 = 6\frac{1}{2}$ yd., the length of room ;

$6\frac{1}{2}$ yd. $+ \frac{1}{2}$ yd. = $6\frac{3}{4}$ yd., the length of strips ;

$6 \times 6\frac{3}{4} = 39\frac{3}{4}$, the number of yards required ;

\$1.62 $\frac{1}{2}$ \times $39\frac{3}{4} = 64.59 , the cost of the carpet.

Page 214.

8. A rug $2\frac{1}{2}$ yd. by 3 yd. will contain $7\frac{1}{2}$ sq. yd. ;

$7\frac{1}{2}$ sq. yd. @ \$1.25 per sq. yd. = \$9.375, the cost of the inside ;

$4\frac{1}{2}$ yd. $+ 4$ yd. $+ 4\frac{1}{2}$ yd. $+ 4$ yd. = 17 yd., the distance around the rug, counting corners twice ;

\$.75 \times 17 = \$12.75, the cost of border ;

\$9.375 $+ $12.75 = 22.125 , the entire cost.

PAPERING.

1. The distance around room is 22 yd., therefore 44 strips will be required ; but the door and windows will make a difference of about 4 strips, leaving 40 to be cut. Since a single roll is 8 yd. long, and since each strip must be 8 ft. long, 3 strips can be cut from a single roll. Hence 14 rolls at least will be needed.

2. The distance around the room is $17\frac{1}{2}$ yd., therefore 35 strips will be needed. Since the room is $9\frac{1}{2}$ ft. from base-board to ceiling, a double roll will cut 5 strips; consequently 7 double rolls will be needed to cut 35 strips.

3. The distance around the room is 21 yd., requiring 42 strips. Since 5 strips can be cut from a double roll, 8 double rolls and 1 single roll will be required.

Page 215.

4. The distance around the room is 20 yd., requiring 40 strips. Since each double roll cuts 5 strips, 8 double rolls will be needed.

5. The distance around the hall is $22\frac{3}{4}$ yd.; this will take 46 strips less 9 strips allowed (3 strips for front door and 2 strips for each of the other five, less 4 strips required for spaces above doors), or 37 strips. Since a double roll will cut 5 strips, 7 double rolls and 1 single roll will be needed.

6. The room will require 40 strips, making no allowance for openings. Allowing 6 strips for $\frac{1}{2}$ of the openings, enough paper must be bought for 34 strips. Since the base-board is 9 in. wide, and the border 18 in. wide, the length of the strips will be 7 ft. 9 in., and 3 strips can be cut from a single roll. Therefore 12 single rolls must be purchased.

$$\$ 1.20 \times 12 = \$ 14.40, \text{ the cost of the paper.}$$

$$\$.50 \times 20 = \underline{10.00}, \text{ the cost of the border.}$$

$$\$ 24.40, \text{ the cost of papering the room.}$$

PAVING.

1. $5 \times 40 = 200$ sq. ft.; $$.25 \times 200 = \$ 50$, the cost.

2. $36 \times 5\frac{1}{2} = 198$ sq. ft.; $198 \div 9 = 22$ sq. yd.;
 $$.1.35 \times 22 = \$ 29.70$, the cost.

3. $20 \times 24\frac{3}{4} = 495$ sq. ft.; $495 \div 9 = 55$ sq. yd.;
 $$.80 \times 55 = \$ 44$, the cost.

4. $260 \times 4\frac{1}{2} = 1170$ sq. ft.;
 $$.22 \times 1170 = \$ 257.40$, the cost of stone walk.
 1170 sq. ft. $\div 9 = 130$ sq. yd.;
 $$.1.08 \times 130 = \$ 140.40$, the cost of brick walk;
 $$.257.40 - \$ 140.40 = \$ 117$, less to make brick walk.

BRICK AND STONE WORK.

Page 216.

- $20 \times 6 = 120$ sq. ft. ; $22 \times 120 = 2640$ bricks.
- Allowing for gate, the wall is 28 ft. long.
 $28 \times 7 = 196$ sq. ft. ; $29 \times 196 = 5684$ bricks ;
 5684 bricks @ \$ 11 per M. = \$ 62.524.
- $36 \times 8 \times 1\frac{1}{2} = 432$ cu. ft. in the wall, on one side of cellar ;
 $432 \times 2 = 864$ cu. ft. in the wall, on both sides of cellar ;
 $24 \times 8 \times 1\frac{1}{2} = 288$ cu. ft. in the wall, on one end of cellar ;
 $288 \times 2 = 576$ cu. ft. in the wall, on both ends of cellar ;
 The total = 1440 cu. ft., including twice the corners.

Each corner is 18 in. square and 8 ft. high ; therefore there are 72 cu. ft. in 4 corners. Subtracting the sum of 72 cu. ft. and 96 cu. ft. from 1440 cu. ft., we have 1272 cu. ft. $1272 \text{ cu. ft.} \div 24\frac{1}{2} = 51\frac{1}{3}$ perches.

- There are 1344 cu. ft. in wall without deducting the corners ;
 $1344 \div 24\frac{1}{2} = 54.30 +$, the number of perches ;
 $\$ 1.60 \times 54.30 + = \$ 86.88 +$, the cost of building the wall.
- $2(44 \text{ ft.} + 38 \text{ ft.}) = 164$ ft., the distance around the cellar ;
 $164 \times 8 \times 2 = 2624$, cu. ft. in walls ;
 $\$.27 \times 2624 = \$ 708.48$, the cost. :

6. $2(32 \text{ ft.} + 30 \text{ ft.}) = 124$ ft. ; $124 \times 25 = 3100$ sq. ft., the area of the outside of house before deducting for openings. The doors are 49 sq. ft. ; windows 216 sq. ft. This sum subtracted from 3100 sq. ft. leaves 2835 sq. ft. ; $29 \times 2835 = 82,215$, the number of bricks required. $82,215$ bricks @ \$ 2 per M. = \$ 164.43, the cost of laying.

Since allowance must be made for corners in estimating materials, we must subtract 4 times $(25 \times 1\frac{1}{2})$, or $133\frac{1}{2}$ sq. ft., from 2835 sq. ft., leaving $2701\frac{1}{2}$ sq. ft. ;

$$29 \times 2701\frac{1}{2} = 78,349, \text{ the number of bricks ;}$$

$$\$ 8.50 \times 78,349 = \$ 665.96, \text{ the cost of material ;}$$

$$\$ 665.96 + \$ 164.43 = \$ 830.39, \text{ the entire cost.}$$

Page 217.

5. $\frac{9 \times 4 \times 4\frac{1}{2}}{128} = 11\frac{7}{8}$ cd.; $\$3.50 \times 11\frac{7}{8} = \4.43 , the cost.
6. $\frac{25 \times 4 \times 5}{128} = 3\frac{5}{8}$ cd.; $\$3.80 \times 3\frac{5}{8} = \$14.84\frac{1}{2}$, the cost.
7. $5 \times \frac{7 \times 3\frac{1}{2} \times 4}{128} = 3\frac{5}{8}$ cd.; $\$3.75 \times 3\frac{5}{8} = \$14.355+$, the cost.
8. $\frac{75 \times 4 \times 5\frac{1}{2}}{128} = 12\frac{3}{4}$ cd.
9. $\frac{24 \times 20 \times 16}{128} = 60$ cd.

BOARD MEASURE.

Page 218.

5. Length multiplied by width = $37\frac{1}{2}$ sq. ft. Multiplying by the thickness in inches, we have 150 ft., board measure.

6. $28 \times 1\frac{1}{2} \times 6 = 196$ board ft.
7. $24 \times \frac{3}{4} \times 9 = 162$ board ft.
8. 25 times $20 \times 1\frac{1}{2} \times 3\frac{1}{2} = 2333\frac{1}{2}$ board ft. ;
 $2333\frac{1}{2}$ board ft. @ \$15 per M. = \$35, the cost.
9. 20 times $18 \times 1\frac{1}{2} \times 2\frac{1}{2} = 1200$ board ft. ;
 1200 board ft. @ \$18 per M. = \$21.60, the cost.
10. $\frac{22 + 16}{2} = 19$ in., the average width ;
 $20 \times 1\frac{7}{8} \times 1\frac{1}{2} = 47\frac{1}{2}$ board ft. ;
 $47\frac{1}{2}$ board ft. @ \$25 per M. = \$1.18\frac{3}{4}, the cost.

CAPACITY OF BINS, ETC.

1. $3 \times 2 \times 2\frac{1}{2} = 15$ cu. ft. ; 1728 cu. in. $\times 15 = 25,920$ cu. in. ;
 $25,920$ cu. in. $\div 2150.42$ cu. in. = $12.053+$, the number of bushels.
2. $4 \times 2\frac{1}{2} \times 3 = 30$ cu. ft. ; 1728 cu. in. $\times 30 = 51,840$ cu. in. ;
 $51,840$ cu. in. $\div 2150.42$ cu. in. = $24.106+$, the number of bushels.
3. $5 \times 3 \times 4\frac{1}{2} = 65$ cu. ft. ; 1728 cu. in. $\times 65 = 112,320$ cu. in. ;
 $112,320$ cu. in. $\div 2150.42$ cu. in. = $52.231+$, the number of bushels.

38 A KEY TO THE STANDARD ARITHMETIC.

4. $5 \times 3\frac{1}{2} \times 6 = 105$ cu. ft. ; 1728 cu. in. $\times 105 = 181,440$ cu. in. ;
 $181,440$ cu. in. $\div 2150.42$ cu. in. $= 84.374 +$, the number of bushels.

5. 2150.42 cu. in. $\times 100 = 215,042$, the number of cu. in. in bin ;
 $215,042$ cu. in. $\div 1728$ cu. in. $= 124.445$, the number of cu. ft.

Dividing the volume by the product of two dimensions will give the other dimension. $124.445 \div (5 \times 5) = 4.977 +$ ft., the height.

6. $11 \times 3\frac{1}{2} \times 2\frac{1}{2} = 96\frac{1}{4}$ cu. ft. ; 1728 cu. in. $\times 96\frac{1}{4} = 166,320$ cu. in. ;
 $166,320$ cu. in. $\div 2150.42$ cu. in. $= 77.343 +$, the number of bushels.

CAPACITY OF CISTERNS.

1. $3 \times 4 \times 5 = 60$ cu. ft. ; 1728 cu. in. $\times 60 = 103,680$ cu. in. ;
 $103,680 \div 231 = 448.8$ gal. ; $448.8 \div 31\frac{1}{2} = 14$ bbl. 7.8 gal.

2. $3\frac{1}{2} \times 4 \times 4 = 56$ cu. ft. ; 1728 cu. in. $\times 56 = 96,768$ cu. in. ;
 $96,768 \div 231 = 418.9$ gal. ; $418.9 \div 31\frac{1}{2} = 13$ bbl. 9.4 gal.

Page 219.

3. $4 \times 4\frac{1}{2} \times 5\frac{1}{2} = 103\frac{1}{2}$ cu. ft. ; 1728 cu. in. $\times 103\frac{1}{2} = 178,848$ cu. in. ;
 $178,848 \div 231 = 774.2337$ gal. ;
 $774.2337 \div 31\frac{1}{2} = 24$ bbl. 18.2337 + gal.

4. $5\frac{1}{2} \times 6 \times 6\frac{1}{2} = 208$ cu. ft. ; 1728 cu. in. $\times 208 = 359,424$ cu. in. ;
 $359,424 \div 231 = 1555.948$ gal. ;
 $1555.948 \div 31\frac{1}{2} = 49$ bbl. 12.448 gal.

5. $5 \times 5 \times 8 = 200$ cu. ft. ; 1728 cu. in. $\times 200 = 345,600$ cu. in. ;
 $345,600 \div 231 = 1496.1038 +$ gal.

6. 6 ft. $\times 3.1416 = 18.849$ ft., circumference ;
 $\frac{1}{2}$ of 6 ft., or $1\frac{1}{2}$ ft. $= \frac{1}{2}$ of the radius ;
 $18.849 \times 1\frac{1}{2} = 28.274$ sq. ft., the area of the bottom.
 $28.274 \times 8 = 226.192$ cu. ft. ;
 1728 cu. in. $\times 226.192 = 390859.776$ cu. in. ;
 $390859.776 \div 231 = 1692.033 +$ gal. ;
 $1692.033 \div 31\frac{1}{2} = 53.716$ bbl.

7. $8 \text{ ft.} \times 3.1416 = 25.1328 \text{ ft.}$, the circumference of cistern ;
 $\frac{1}{2}$ of 8 ft., or 2 ft. = $\frac{1}{2}$ of the radius ;
 $25.1328 \times 2 = 50.2656 \text{ sq. ft.}$, area of bottom ;
 $50.2656 \times 16 = 804.2496 \text{ cu. ft.}$, the volume ;
 $1728 \text{ cu. in.} \times 804.2496 = 1389743.3088 \text{ cu. in.}$;
 $1389743.3088 \div (231 \times 31\frac{1}{2}) = 190.99 + \text{ bbl.}$

GENERAL REVIEW EXERCISES—ORAL.

Page 220.

1. If 3 pears cost $5\frac{2}{3}\text{\$}$, each pear will cost $\frac{1}{3}$ of $5\frac{2}{3}\text{\$}$, or $\frac{2}{9}\text{\$}$, and 5 pears will cost 5 times as much, or $9\text{\$}$.
2. If 5 peaches cost $6\frac{2}{3}\text{\$}$, 1 peach will cost $\frac{1}{5}$ of $6\frac{2}{3}\text{\$}$, or $\frac{2}{5}\text{\$}$, and 9 peaches will cost 9 times as much, or $12\text{\$}$.
3. Since 6 oranges cost $6\frac{2}{3}\text{\$}$, 1 orange will cost $1\frac{1}{3}\text{\$}$, and 7 oranges will cost 7 times that, or $8\text{\$}$.
4. If 8 books are worth $\$11\frac{1}{2}$, 1 book is worth $\frac{1}{8}$ of $\$11\frac{1}{2}$, or $\$1\frac{3}{16}$, and 10 books are worth 10 times as much, or $\$14$.
5. If 9 ducks cost $\$6\frac{2}{3}$, 1 duck will cost $\frac{1}{9}$ of $\$6\frac{2}{3}$, or $\$7\frac{2}{9}$, and 14 ducks will cost 14 times as much, or $\$10$.
6. If 4 pigs cost $\$13\frac{1}{2}$, 12 pigs will cost 3 times as much, or $\$39\frac{1}{2}$.
7. Since $\$56$ is 4 times as much as $\$14$, 4 times as many sheep can be bought for $\$56$ as for $\$14$; therefore 16 sheep can be bought.
8. Since the man paid $\$72$ for potatoes, and the rate was $\$8$ for $9\frac{1}{2}$ bu., he must have bought for $\$72$, 9 times $9\frac{1}{2}$ bu., or 84 bu.
9. Since 5 yd. are worth $7\frac{2}{11}$ dimes, 1 yd. is worth $\frac{1}{5}$ of $7\frac{2}{11}$ dimes, or $1\frac{2}{11}$ dimes, and 22 yd. are worth 22 times that sum, or 34 dimes.
10. Since 5 shovels sell for $\$3\frac{1}{2}$, 1 shovel sells for $\frac{1}{5}$ of $\$3\frac{1}{2}$, or $\$1\frac{1}{10}$, and 8 shovels sell for 8 times that, or $\$5\frac{1}{2}$.
11. If $\frac{1}{3}$ of a barrel of flour costs $\$5$, $\frac{1}{6}$ of a barrel will cost $\frac{1}{2}$ of $\$5$, or $\$1\frac{1}{2}$, and a whole barrel will cost 5 times $\$1\frac{1}{2}$, or $\$6\frac{1}{2}$, and 7 barrels will cost 7 times $\$6\frac{1}{2}$, or $\$43\frac{1}{2}$.

12. Since he gave $\frac{1}{5}$ of his salary for a coat, and $\frac{1}{5}$ for board, he gave for both $\frac{2}{5}$ of his salary, and consequently had $\frac{3}{5}$ left, which was equal to \$33. Since $\frac{3}{5}$ of his salary was \$33, $\frac{1}{5}$ of it was $\frac{1}{3}$ of \$33, or \$11, and his entire salary was 20 times \$11, or \$220.

13. Since $\frac{1}{3}$ of the trees bear apples, and $\frac{1}{3}$ peaches, the apple and peach trees constitute $\frac{2}{3}$ of the entire number; therefore the other trees are $\frac{1}{3}$ of the number, which is 30. Since $\frac{1}{3}$ of the number is 30, $\frac{1}{12}$ of it is $\frac{1}{4}$ of 30, or 7.5, and the entire number is 12 times 7.5, or 90.

Page 221.

14. If $\frac{2}{3}$ of a ship is worth \$15,000, $\frac{1}{3}$ of it is worth $\frac{1}{2}$ of \$15,000, or \$7,500, and $\frac{1}{3}$ of it is worth 5 times \$7,500, or \$37,500.

15. Since 80¢ was $\frac{1}{12}$ of his money, $\frac{1}{12}$ of his money was $\frac{1}{80}$ of 80¢, or 1¢, and his whole money was 12 times 1¢, or 12¢. Since he spent 80¢ for a book, he had 16¢ left, and since he bought oranges @ 2¢ apiece with that sum, he must have bought 8 oranges.

16. Since \$30 was $\frac{3}{5}$ of the value of the goods, the entire value of the goods was \$50. Since he gets \$3.75 per cd. for his wood, or \$10 for 3 cd., it will require 2 times 3 cd., or 6 cd., to pay for the remainder of the goods.

17. If 7 men can do the work in 10.5 days, it will take 1 man 7 times 10.5 days to do it, or 73.5 days, and it will require 9 men $\frac{1}{3}$ of 73.5 days to do the work, or 24.5 days.

18. Since it required 6 da. for 20 men to load a vessel, it would have required 120 da. for 1 man to load it, and it will require as many men to load it in 2.5 da. as 2.5 is contained times in 120, or 48 men.

19. If it costs \$40 to support a family of 8 persons for 2.5 weeks, it will cost \$5 to support 1 person for 2.5 weeks, or \$2 to support 1 person a week. It will therefore cost 11 times \$2, or \$22, to support 11 persons a week, and 4 times \$22, or \$88, to support 11 persons 4 weeks.

20. Since he paid half of his money for a horse, he had $\frac{1}{2}$ of it left, and since he paid $\frac{1}{4}$ of that sum for a suit of clothes, he must have given $\frac{1}{4}$ of his money for a suit of clothes. The horse and the clothes cost $\frac{3}{4}$ of his money, consequently he had but $\frac{1}{4}$ left after making those purchases. Since he spent $\frac{1}{3}$ of the $\frac{1}{4}$, or $\frac{1}{12}$, for provisions, he had $\frac{1}{6}$, or $\frac{1}{6}$, of his money left, and that was equal to \$60. Since $\frac{1}{6}$ of his money was \$60, his entire money was 4 times \$60, or \$240.

21. Since the first can do $\frac{1}{10}$ of the work in a day, the second $\frac{1}{12}$ of it, and the third $\frac{1}{15}$ of it, they can all together do the sum of $\frac{1}{10}$, $\frac{1}{12}$, and $\frac{1}{15}$ of the work, or $\frac{1}{6}$ of the work, or $\frac{1}{4}$ of the work, in a day; consequently they can do the whole in 4 days.

22. Since $\frac{1}{2}$ of Charles's money is equal to $\frac{1}{3}$ of Henry's, the whole of Charles's money must be equal to $\frac{2}{3}$ of Henry's; consequently Charles's money is $\frac{1}{3}$ of Henry's more than Henry's, which is equal to \$12. Since $\frac{1}{4}$ of Henry's money is \$12, his money must be 7 times \$12, or \$84, and Charles's is \$12 more, or \$96.

23. Since the shadow is 17 ft. long, and the pole is 12 ft. long, to cast a shadow 85 ft. long, the pole must be 5 times 12 ft., or 60 ft., long, since the longer shadow is 5 times the length of the shorter.

24. Since the horse cost $\frac{1}{5}$ as much as the carriage, both together must have cost $1\frac{1}{5}$ times as much as the carriage; therefore $\frac{1}{5}$ of the cost of the carriage was \$400; $\frac{1}{5}$ of the cost of the carriage $\frac{1}{5}$ of \$400, or \$80, and the entire cost of the carriage 5 times \$80, or \$400. Hence cost of the horse was \$80.

25. Since 100 votes were $\frac{1}{10}$ of all that were cast, the whole number cast must have been 10 times 100, or 1000. Since the successful candidate had a majority of 100, if both had received the same number as the unsuccessful candidate, the total vote would have been 1000 - 100, or 900, and each would then have received $\frac{1}{2}$ of 900, or 450, votes; consequently, the defeated candidate received 450 votes, and the successful one 100 votes more, or 550.

Page 222.

26. If A has $3\frac{1}{2}$ times as much as B, and C has as much as A and B, C must have $4\frac{1}{2}$ times as much as B, and they all will have $1 + 3\frac{1}{2} + 4\frac{1}{2}$, or 9 times as much as B; therefore 9 times what B has is \$2700, and B's money is \$300, A's $3\frac{1}{2}$ times \$300, or \$1050, and C's \$1350.

27. Since the length, breadth, and thickness of the cube are each 3 in., it has 6 faces each of which has a surface of 9 sq. in., or the entire surface is 54 sq. in.

28. Since the first can do $\frac{1}{15}$ of it in a day, and the second $\frac{1}{20}$ of it, both can do $\frac{1}{15} + \frac{1}{20}$, or $\frac{1}{12}$, of it in a day. Since the 3 can do $\frac{1}{4}$ of

the work in a day, and 2 of them can do $\frac{7}{8}$ of it, the third can do $\frac{1}{8} - \frac{7}{8}$, or $\frac{1}{8}$, of it in a day; therefore he will require 12 days to do the work.

29. Since the first paid for $\frac{1}{3}$ of it, and the second for $\frac{1}{3}$ of it, both paid for $\frac{2}{3}$ of it, and the third must have paid for $\frac{1}{3}$ of it. Since he paid for $\frac{1}{3}$ of the machine, he should receive $\frac{1}{3}$ of the gain, or $\frac{1}{3}$ of \$300, which is \$125.

30. Since $\frac{1}{6}$ of his money, and 10 cents, was equal to the whole of his money, 10 cents must have been $\frac{1}{6}$ of his money; hence his money was 6 times 10 cents, or 60 cents.

31. Of every \$12 earned by them, A earns \$3, B \$4, and C \$5; consequently A earns $\frac{1}{4}$, B $\frac{1}{3}$, and C $\frac{1}{2}$ of their aggregate earnings. Since the earnings were \$60, A earned \$15, B \$20, and C \$25.

32. Since he paid $1\frac{1}{2}$ cents apiece for them, and sold them at $1\frac{1}{2}$ cents apiece, he gained $\frac{1}{2}$ of a cent on each, and gained 1 cent on every 12 oranges sold; therefore, to gain 25 cents, he must have sold 25 times 12 oranges, or 300 oranges.

33. Since the hound gains 1 rod upon every 12 that the fox runs, the fox can run 12 times 90 rods, or 1080 rods, before he is caught.

34. Since $\frac{1}{3}$ of a number is 12 more than $\frac{1}{4}$ of it, the difference between $\frac{1}{3}$ and $\frac{1}{4}$ or $\frac{1}{12}$ of the number = 12, $\frac{1}{12}$ of the number is 12 more than $\frac{1}{12}$ of it; therefore the number is 12 times 12, or 144.

35. A number plus $\frac{1}{4}$ of it and $\frac{1}{5}$ of it is $\frac{9}{20}$ of it; therefore $\frac{9}{20}$ of the number is 87, $\frac{1}{20}$ of it $\frac{1}{9}$ of 87, or 3, and the number 20 times 3, or 60.

Page 223.

36. Since there are 24 sheets in a quire, and 20 quires in a ream, there are 480 sheets in a ream. Since, in making an octavo book, each sheet is folded into 8 leaves or 16 pages, and the book contains 480 pages, 30 sheets will be required to make the book; or, since there are 480 sheets in a ream of paper, a ream will make 16 books. Therefore, to print an edition of 1600 books, 100 reams will be needed.

37. Since one took 7 cd. and the other 8 cd., there were 15 cd.; hence one should pay $\frac{7}{15}$ of \$45, which is \$21, and the other $\frac{8}{15}$ of \$45, which is \$24.

38. The pasturage of 4 horses for 5 weeks is equal to the pasturage of 20 horses for 1 week, and the pasturage of 5 horses for 6 weeks is the same as the pasturage of 30 horses for 1 week; therefore A had in the field the equivalent of 20 horses for 1 week, and B 30 horses for 1 week, or both had the equivalent of 50 horses for 1 week. A should therefore pay $\frac{2}{5}$, or $\frac{2}{5}$, of the cost, which is \$12, and B should pay $\frac{3}{5}$, or $\frac{3}{5}$, of it, which is \$18.

39. If $\frac{1}{8}$ of a number is added to itself, the sum will be $\frac{1}{4}$ of the number. Since, when 17 is added to $\frac{1}{4}$ of the number, the sum is 82, $\frac{1}{4}$ of the number is 17 less than 82, or $\frac{1}{4}$ of the number is 65. Since $\frac{1}{4}$ of the number is 65, $\frac{1}{8}$ of it is $\frac{1}{8}$ of 65, or 5, and the number is 8 times 5, or 40.

40. Both can do $\frac{1}{15}$ of the work per day. Since R does $\frac{2}{3}$ as much as W, out of every 5 parts of the work done by both, W does 3 parts, and R 2 parts, hence W does $\frac{3}{5}$, and R $\frac{2}{5}$, of the work which both together do. Since both do $\frac{1}{15}$ of the work in a day, W does $\frac{3}{15}$, or $\frac{1}{5}$, of it per day, and he can do the whole in 25 days; and R does $\frac{2}{15}$, or $\frac{2}{15}$, of it in a day, and he can do the whole in $37\frac{1}{2}$ days.

41. Since A owns 3 times as much land as C, and B 4 times as much, the quantity that all own must be $1 + 3 + 4$, or 8 times what C owns, which is 720 acres; therefore C owns $\frac{1}{8}$ of 720 acres, or 90 acres, B 360 acres, A 270 acres.

42. Since S has $\frac{2}{3}$ as much money as V, and T has $\frac{1}{3}$ as much as V, altogether they must have $\frac{1}{3} + \frac{2}{3} + \frac{1}{3}$, or $\frac{4}{3}$, times as much as V's money, which is \$580. Since $\frac{4}{3}$ of V's money is \$580, $\frac{1}{3}$ is $\frac{1}{3}$ of \$580, or \$20, and the whole of V's money is 12 times \$20, or \$240; T's is $\frac{1}{3}$ of \$240, or \$80; and S's is $\frac{2}{3}$ of \$240, or \$160.

43. Since 3 men can do the work in 20 days, it will require 60 days for 1 man to do it. Since 5 boys do as much as 3 men, 10 boys will do as much as 6 men, and 4 men and 10 boys as much as 10 men. Since 1 man can do the work in 60 days, 10 men can do it in $\frac{1}{10}$ of 60 days, or 6 days.

44. Since the work can be done by 5 men in 12 days, it will require 1 man 5 times 12, or 60, days to do it; since 8 boys do as much work as 5 men, 5 men and 8 boys will do as much work as 10 men; therefore it will require 5 men and 8 boys, or 10 men, as many days to do the work as 10 is contained times in 60 days, which is 6 days.

44 A KEY TO THE STANDARD ARITHMETIC.

45. Since he put into the first 3 bins $\frac{2}{3}$ plus $\frac{1}{4}$ plus $\frac{1}{5}$, or $\frac{23}{60}$, of his grain, into the fourth bin he must have put the rest, or $\frac{37}{60}$, which was 56 bu. Since $\frac{37}{60}$ of his grain was 56 bu., $\frac{1}{60}$ of it was $\frac{1}{6}$ of 56 bu., or 8 bu., and the whole quantity was 40 times 8 bu., or 320 bu.

46. $\frac{2}{3}$ of the price of the cow was \$30, hence \$30 was $\frac{2}{3}$ of the cost of the horse. Since \$30 was $\frac{2}{3}$ of the cost of the horse, $\frac{1}{3}$ of the cost was $\frac{1}{2}$ of \$30, or \$15, and the whole cost was 9 times \$15, or \$135.

47. Since the man had \$3400 after he had gained \$700, he had \$2700 before he gained any, and that was the amount he had left after he had lost $\frac{2}{3}$ of his money; therefore \$2700 was $\frac{1}{3}$ of his money. Since \$2700 was $\frac{1}{3}$ of his money, $\frac{1}{3}$ of it was $\frac{1}{3}$ of \$2700, or \$900, and the whole of his money was 5 times \$900, or \$4500. Since he lost $\frac{2}{3}$ of \$4500, or \$3000, and gained \$700, his total loss was \$3000 - \$700, or \$2300.

Page 224.

48. Since I paid \$1.50 for flour at the rate of \$6 per barrel, I must have purchased $\frac{1}{4}$ of a barrel, and since a barrel of flour contains 196 lb., I must have purchased $\frac{1}{4}$ of 196 lb., or 49 lb.

49. Since $\frac{2}{3}$ of the first part was equal to $\frac{1}{3}$ of the second, $\frac{1}{3}$ of the first part was equal to $\frac{1}{6}$ of the second, and the whole of the first part was equal to 5 times $\frac{1}{6}$, or $\frac{5}{6}$, of the second. The sum of both parts was, therefore, $\frac{11}{6}$ of the second part, which made the entire length of the pole, or 76 ft. Since $\frac{5}{6}$ of the second part was 76 ft., $\frac{1}{6}$ of the second part was $\frac{1}{5}$ of 76 ft., or 15.2 ft., and the whole length of that part was 9 times 15.2 ft., or 136.8 ft.; therefore the length of the other part was 40 ft.

50. Since the man sold $\frac{3}{4}$ of $\frac{1}{4}$ of the vessel, he sold $\frac{3}{16}$ of it. Since $\frac{3}{16}$ of the value of the vessel was \$1200, $\frac{1}{16}$ of it was $\frac{1}{3}$ of \$1200, or \$400, and the value of the whole vessel was 16 times \$400, or \$6400.

51. Since a lot 7 rd. square contains 49 sq. rd., 5 lots contain 5 times 49 sq. rd., or 245 sq. rd. Since the other 3 lots contain 10 sq. rd. each, the entire amount of land is 245 sq. rd. + 30 sq. rd., or 275 sq. rd.

52. Since each face of the cubical block is 6 in. square, the surface of each will be 36 sq. in., and since there are 6 faces, the entire surface will be 6 times 36 sq. in., or 216 sq. in.

GENERAL REVIEW EXERCISES—WRITTEN.

Page 225.

12. $\$120 \div (1\frac{1}{4} \times 590) = \$.16\frac{1}{3}$, the cost of transporting 1 ton 1 mile; $\$.16\frac{1}{3} \times (2\frac{1}{2} \times 400) = \162.71 , the cost of transporting 2½ tons 400 miles.

13. Since 25 bushels will last 16 sheep 13 weeks, twice as many bushels will last 16 sheep twice as long a time, and it will last $\frac{1}{2}$ as many sheep 4 times as long, or 52 weeks.

14. 28 barrels of potatoes @ \$1.75 per barrel = \$49.00; therefore I can buy as many kegs of nails @ \$3.50 per keg as \$49.00 is contained times in \$49, or 14 kegs.

15. Since $\frac{1}{7}$ of an acre is worth \$80, $\frac{1}{8}$ of an acre is worth $\frac{1}{7}$ of \$80, or \$11 $\frac{2}{7}$; and an acre is worth 8 times \$11 $\frac{2}{7}$, or \$91 $\frac{2}{7}$; $\frac{3}{4}$ of an acre is worth $\frac{3}{4}$ of \$91 $\frac{2}{7}$, or \$68.57.

16. Since $\frac{1}{7}$ of a vessel is worth \$17,000, $\frac{1}{17}$ is worth $\frac{1}{7}$ of \$17,000, or \$3400; and the whole vessel is worth 17 times \$3400, or \$57,800. Therefore $\frac{1}{7}$ of a vessel is worth $\frac{1}{7}$ of \$57,800, or \$8,257.

17. $(\$50.36 \div 38\frac{1}{3}) \times 75 = \97.849 .

18. 186 yards of muslin @ 6 $\frac{2}{3}$ ¢ per yard = \$12.40. As many pounds of butter at 24¢ a pound must be given in exchange as \$12.40 is contained times in \$12.40, or 51 $\frac{1}{3}$ pounds.

19. 65 sheep at \$3 $\frac{1}{2}$ apiece cost \$211.25. He must give as much hay at \$9 $\frac{1}{2}$ per ton as \$211.25 is contained times in \$211.25, or 22 $\frac{3}{8}$ tons.

20. 96 oxen at \$42 $\frac{1}{2}$ each cost \$4080. I can get as much land at \$45 per acre as \$4080 is contained times in \$4080, or 90 $\frac{2}{3}$ A.

21. Since 12 times E's portion = 13 times F's portion, $\frac{1}{12}$ of F's portion = $\frac{1}{13}$ of E's portion, and F's portion = $\frac{1}{12}$ of E's portion. $\frac{1}{12}$ of E's portion plus E's portion, or $\frac{13}{12}$ of E's portion = 26,750 acres; $\frac{1}{12}$ of E's portion = 1070 acres; E's portion = 13 times 1070 acres, or 13,910 acres; $\frac{1}{12}$ of 13,910 acres = 1,159 acres, F's portion.

22. For every pound that C owns, A owns 7 pounds, and B owns 9 pounds; that is, of every 17 pounds, C owns 1, A 7, and B 9 pounds. Therefore C owns $\frac{1}{17}$ of 97,937 pounds, or 5761 pounds; A owns $\frac{7}{17}$ of 97,937 pounds, or 40,327 pounds; B owns $\frac{9}{17}$ of 97,937 pounds, or 51,849 pounds.

Page 226.

23. The sum, 9232, plus the difference, 427 = 9659, twice the greater number; $\frac{1}{2}$ of 9659 = 4829 $\frac{1}{2}$, the greater number. $4829\frac{1}{2} - 427 = 4402\frac{1}{2}$, the less number.

24. $1\frac{1}{3}\frac{7}{4}$, the sum, minus $\frac{1}{4}$, the difference, = $1\frac{2}{3}\frac{3}{4}$, twice the less number. $1\frac{2}{3}\frac{3}{4} + 2 = 3\frac{2}{3}\frac{3}{4}$, the less number; $3\frac{2}{3}\frac{3}{4} + \frac{1}{4} = 3\frac{1}{2}\frac{1}{4}$, the greater number.

25. The value of the second farm and $\frac{5}{8}$ of it + \$1560 = \$20,491; or $\frac{1}{8}$ of the value of the second farm + \$1560 = \$20,491. Then, $\frac{1}{4}$ of the value of the second farm = \$18,931; $\frac{1}{8}$ of the value of the second farm = \$1721; The value of the second farm = \$10,326; $\frac{3}{8}$ of second farm + \$1560 = \$10,165, the value of first farm.

26. The difference between 21 times the property and 7 times the property = 14 times the property. Since 14 times the property = \$32,200, the property is $\frac{1}{14}$ of \$32,200, or \$2300.

27. Twice a number + $\frac{5}{8}$ of the number, subtracted from 3 times the number = $\frac{1}{8}$ of the number. Since $\frac{1}{8}$ of the number = \$2691, $\frac{1}{8}$ of the number = 207; and the number = 18 times 207, or 3726.

28. Five times a number - $\frac{2}{3}$ of the number = $4\frac{1}{3}$ times the number; $4\frac{1}{3}$ times the number - 4 times the number = $\frac{1}{3}$ of the number. Since $\frac{1}{3}$ of the number = 1265, $\frac{1}{7}$ of number = $\frac{1}{7}$ of 1265, or 253; and the number = 7 times 253, or 1771.

29. 23.8 acres @ \$37.50 per acre = \$892.50.

30. (80 rd. + 120 rd.) \div 2 = 100 rd., the average length of sides;
160 sq. rd. \times 100 = 16,000 sq. rd., the area of the trapezoid;
16,000 \div 100 = 160 rd., the distance between parallel sides.

31. 6 ft. \times 3.1416 = 18.8496 ft., the circumference;
 $\frac{1}{4}$ of 6 ft., or $1\frac{1}{2}$ ft. = $\frac{1}{2}$ of the radius;
18.8496 \times $1\frac{1}{2}$ = 28.2744 sq. ft., area of bottom;
28.2744 \times 6 = 169.6464 cu. ft., the volume;
169.6464 \times 1728 = 293,148.979 cu. in. in the volume;
293,148.979 cu. in. \div (231 \times 31 $\frac{1}{2}$) = 40.287 bbl.

32. $(63 \times 4 \times 8) + 128 = 15\frac{1}{2}$ cd. ; $\$4.75 \times 15\frac{1}{2} = \$74.81\frac{1}{2}$.
33. $35 \times 28 \times 6 = 5880$ cu. ft. ; $5880 \div 27 = 217\frac{2}{3}$ cu. yd. ;
 $\$.45 \times 217\frac{2}{3} = \98 , the cost.
34. $2(30 \times \frac{1}{2} \times 10) = 500$ board ft. ;
 500 board ft. @ $\$30$ per M. = $\$15$, the cost.
35. $231 \times 31\frac{1}{2} = 7276\frac{1}{2}$, the number of cubic inches in a barrel ;
 $7276\frac{1}{2} \div 1728 = 4\frac{27}{28}$ cu. ft.

Since there are $4\frac{27}{28}$ cu. ft. in a barrel, therefore a barrel will weigh $4\frac{27}{28}$ times as much as a cu. ft. ; 62 lb. 8 oz. $\times 4\frac{27}{28} = 2$ cwt. 63 lb. $21\frac{1}{2}$ oz.

Page 227.

36. A paid $\frac{3}{10}$, or $\frac{3}{10}$ of the cost, and should therefore receive $\frac{3}{10}$ of the gain. $\frac{3}{10}$ of $\$40 = \12 , A's share of the gain. B paid $\frac{7}{10}$ of the cost, and is entitled to $\frac{7}{10}$ of the gain. $\frac{7}{10}$ of $\$40 = \28 , B's share of the gain.

37. M and N together furnish $\$1600$ capital, of which M, furnishing $\$900$, is entitled to $\frac{9}{16}$, or $\frac{9}{16}$ of the gain ; $\frac{9}{16}$ of $\$320 = \180 , M's share.

N has $\frac{7}{16}$ of the capital, and therefore is entitled to $\frac{7}{16}$ of the gain. $\frac{7}{16}$ of $\$320 = \140 , N's share.

38. $\frac{1}{15} - \frac{1}{25} = \frac{2}{75}$. D can dig $\frac{2}{75}$ of the well in one day, or the well in $37\frac{1}{2}$ days. Since he can do the whole work in $37\frac{1}{2}$ days, he can do $\frac{1}{2}$ of the work in $\frac{1}{2}$ of $37\frac{1}{2}$ days, or $28\frac{1}{2}$ days.

39. Together they furnish $\$4500$ capital. One has $\frac{2}{3}$ of the capital ; he is entitled, therefore, to $\frac{2}{3}$ of the gain ; $\frac{2}{3}$ of $\$900 = \600 . The other has $\frac{1}{3}$ of the capital, and is therefore entitled to $\frac{1}{3}$ of the gain ; $\frac{1}{3}$ of $\$900 = \300 .

40. H's loss, $\frac{1}{7}$ of $\$493 = \$70\frac{4}{7}$;
 K's loss, $\frac{1}{7}$ of $\$493 = \$70\frac{4}{7}$.

41. At the end of 30 days, he should have received $\$90$. Subtracting $\$15$ for board would leave a net amount of $\$75$. Since he received but $\$60$, he was $\$15$ deficient ; therefore, as he was working for $\$3$ per day, he must have been idle as many days as 3 is contained times in 15, or 5 days.

43. Mr. SAMUEL GRAND

Bought of Messrs. COX & DAVIS.

24 pr. kip boots @ \$2.50 a pr.	\$ 60	00
18 pr. kid slippers @ \$1.80 a pr.	32	40
36 pr. boys' shoes @ \$1.20 a pr.	43	20
24 pr. overshoes @ 45¢ a pr.	10	80
Received payment,	\$ 146	40
COX & DAVIS.		

43. The pasturage of 26 } = the pasturage of 234 sheep for 1 week ;
 sheep for 9 weeks }
 The pasturage of 37 } = the pasturage of 407 sheep for 1 week ;
 sheep for 11 weeks }
 The pasturage of the } = the pasturage of 641 sheep for 1 week.
 whole number }

Since \$75 pays for pasturing 641 sheep for one week, one man must pay $\frac{2}{11}$ of \$75, or \$27.379, and the other must pay $\frac{4}{11}$ of \$75, or \$47.621.

44. Together they work 122 days, and receive \$219.60 for their work, which is \$1.80 per day. The first then receives 36 times \$1.80, or \$64.80; the second receives 41 times \$1.80, or \$73.80; the third receives 45 times \$1.80, or \$81.00.

45. Since one receives $\frac{1}{7}$ of the gain, he must have furnished $\frac{1}{7}$ of \$5000, the capital, which is \$3000.

Page 228.

46. Since the wall is 16 in. thick, a section of it 1 ft. long, 1 ft. wide, and 16 in. thick contains 29 bricks. Hence

$42 \times 15 \times 29 = 18270$, the number of bricks without deduction for gate

$10 \times 10 \times 29 = 2900$, the number of bricks to be deducted for gate ;

15370, the number of bricks laid in the wall.

$\$11.50 \times 15.370 = \176.755 , the cost of the bricks laid ;

$\$176.755 + \$9.45 = \$186.205$, the entire cost.

47. $80 \text{ rd.} \times 3.1416 = 251.328 \text{ rd.}$, the circumference ;
 $251.328 \text{ rd.} \div 4 = 62.832 \text{ rd.}$, one side of the square field ;
 $62.832 \times 62.832 = 3947.86022 \text{ sq. rd.}$, the area of field ;
 $3947.86022 \div 160 = 24.674+$, the number of acres.
48. $\frac{1}{5}$ or $\frac{1}{5}$ of 560 bu. = 112 bu., A's share of the wheat ;
 $\frac{2}{5}$ or $\frac{2}{5}$ of 560 bu. = 224 bu., B's share of the wheat ;
 $\frac{2}{5}$ or $\frac{2}{5}$ of 560 bu. = 224 bu., C's share of the wheat.
49. He can pay $\frac{1}{4}$ of a dollar, or $\$.7109+$ on every dollar he owes ;
 $\$.7109 \times 480 = \$341.232+$.

50. Should 15 persons pay for the land, each one would pay $\frac{1}{15}$ of the cost. Since 3 withdraw, each must pay $\frac{1}{12}$ of the cost. The difference between $\frac{1}{12}$ and $\frac{1}{15}$ of the cost is $\frac{1}{60}$ of the cost ; therefore $\frac{1}{60}$ of the cost = $\$150$; and the entire cost = 60 times $\$150$, or $\$9000$.

51. $\frac{1}{3}$ of $\$1800 = \600 , A's gain ;
 $\frac{2}{3}$ of $\$1800 = \1200 , B's gain ;
 $\frac{1}{3}$ of $\$1800 = \600 , C's gain.
52. $\frac{1}{2}$ of first = $\frac{1}{3}$ of second ; $\frac{1}{2}$ of first = $\frac{1}{3}$ of second ;
 \therefore The first = $\frac{2}{3}$ of second. The difference, or $\frac{1}{3}$ of second, = 1'.
 \therefore The second = 816 ; $\frac{2}{3}$ of 816 = 544, the first.

53. Since each horse cost 3 times as much as each cow, the cost of 3 horses was equal to the cost of 9 cows. Since each cow cost 3 times as much as each sheep, 9 cows and 6 cows cost as much as 45 sheep. 45 sheep + 20 sheep = 65 sheep. Since 65 sheep cost $\$650$, each sheep cost $\$10$; each cow 3 times as much, or $\$30$; each horse 3 times the cost of a cow, or $\$90$.

54. $\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$; $\frac{1}{2} - \frac{1}{4} = \frac{1}{4}$, C's share of the gain ;
 $\frac{1}{4}$ of $\$700 = \175 ; $12 \times \$175 = \2100 , the entire capital ;
 $\frac{1}{2}$ of $\$2100 = \1050 , A's capital ; $\frac{1}{4}$ of $\$2100 = \525 , B's capital ;
 $\frac{1}{4}$ of $\$2100 = \525 , C's capital.

55. The money he had left + $\frac{1}{2}$ of what he had left = $\frac{3}{2}$ of what he had at first ; or, $\frac{1}{2}$ of what he had left = $\frac{1}{2}$ of what he had at first ; $\frac{1}{2}$ of what he had left = $\frac{1}{2}$ of $\frac{1}{2}$, or $\frac{1}{4}$ of what he had at first ; the money he had left = 4 times $\frac{1}{4}$, or $\frac{1}{4}$ of what he had at first. Therefore the money lost, or $\$600$, must equal $\frac{3}{4}$ of what he had at first ; therefore $\frac{1}{4}$ of what he had at first = $\$200$; and the money he had at first was 7 times $\$200$, or $\$1400$.

56. $\$1850 + \$1950 + \$2050 = \5850 , the entire capital ;
 $\frac{1}{3}\frac{1}{3}\frac{1}{3}$ of $\$2000 = \$632.478+$, A's loss ;
 $\frac{1}{3}\frac{1}{3}\frac{1}{3}$ of $\$2000 = \$666.66\frac{2}{3}+$, B's loss ;
 $\frac{1}{3}\frac{1}{3}\frac{1}{3}$ of $\$2000 = \$700.854+$, C's loss.

Page 229.

57. The grocer cheats his customers out of $\frac{1}{2}$ pint in every 8 pints, or $\frac{1}{16}$ of their money ; $\frac{1}{16}$ of $\$350 = \$21.87\frac{1}{2}$.

58. $12\frac{3}{4}$ = the sum of two numbers ;
 $2\frac{1}{2}$ = the difference between the numbers ;
 $12\frac{3}{4} - 2\frac{1}{2} = 10\frac{5}{8}$, twice the less number ;
 $10\frac{5}{8} \div 2 = 5\frac{5}{8}$, the less number ;
 $5\frac{5}{8} + 2\frac{1}{2} = 7\frac{1}{8}$, the greater number.

59. Since $\frac{1}{3}$ of the remainder of the sheep cost $\$150$, $\frac{1}{3}$ of the remainder cost $\$37\frac{1}{2}$, and the cost of the entire remainder was $\$187\frac{1}{2}$.
 $\$225 - \$187\frac{1}{2} = \$37\frac{1}{2}$, the cost of 10 sheep, which was $\$3\frac{3}{4}$ per head.
 $\$225 \div \$3\frac{3}{4} = 60$, the number of sheep bought.

60. $\$750 + \$820 + \$900 = \2470 , the amount the bankrupt owes ;
 $\$1500 \div \$2470 = .60728+$, the part of a dollar he can pay ;
 $\$.60728 \times 750 = \$455.46+$, what the first receives ;
 $\$.60728 \times 820 = \$497.97+$, what the second receives ;
 $\$.60728 \times 900 = \$546.55+$, what the third receives.

61. 3 teams for 15 days = 45 teams for one day ;
 4 teams for 18 days = 72 teams for one day ;

Therefore 117 teams for one day earn $\$600$, or one team earns $\$5.1282$ in one day ; 3 teams for 15 days will earn 45 times $\$5.1282$, or $\$230.77$; and 4 teams for 18 days will earn 72 times $\$5.1282$, or $\$369.23$.

62. Since the first farm cost $\$400$ more than the second, and the third farm $\$500$ less than the second, the three farms cost 3 times as much as the second, lacking $\$100$. Therefore 3 times the value of the second farm = $\$15,100$. Hence the second farm was worth $\frac{1}{3}$ of $\$15,100$, or $\$5033\frac{1}{3}$; the first was worth $\$5033\frac{1}{3} + \400 , or $\$5433\frac{1}{3}$, and the third was worth $\$5033\frac{1}{3} - \$500 = \$4533\frac{1}{3}$.

63. $(28 \times 42) \times 2 = 2352$ sq. ft., in the roof;
 2352 sq. ft. @ \$18 per M. = \$42.336, the cost of the lumber;
 2352 sq. ft. $\times 3 = 7056$, the number of slates to cover the roof.
64. The estate paid $\frac{3}{8}$ of the debt, or \$.8179+ on a dollar.
65. While F earned \$1, E earned \$3 and D earned \$12. Therefore F earned $\frac{1}{16}$ of \$3936, or \$246; E earned $\frac{3}{16}$ of \$3936, or \$738; and D $\frac{12}{16}$ of \$3936, which is \$2952.
66. $\frac{1}{4}$ mile = 1320 ft.; $1320 \times 60 = 79,200$ sq. ft., the area of the street;
 $\$.22 \times 79,200 = \$17,424$, the cost of paving with asphalt;
 $79,200$ sq. ft. $\div 9 = 8800$ sq. yd.;
 $\$.3.10 \times 8800 = \$27,280$, the cost of paving with granite blocks;
 $\$27,280 - \$17,424 = \$9856$, cheaper with asphalt.

Page 230.

67. 4815 cords at 50¢ per cd. = \$2407.50. They together furnish 12 teams; therefore one man should receive $\frac{1}{12}$, or $\frac{1}{4}$, of \$2407.50, or \$601.875; another $\frac{1}{12}$, or $\frac{1}{4}$, of \$2407.50, or \$602.50; the other $\frac{1}{12}$ of \$2407.50, or \$1003.125. $\$2407.50 \div (12 \times 36) = \5.57 , the sum each team earned per day.
68. $2(45 \text{ rd.} + 36 \text{ rd.}) = 162$ rd.;
 $16\frac{1}{2} \times 162 = 2673$ ft., the distance around the field;
 $2673 \div 12 = 222\frac{3}{4}$, the number of panels of fence.
69. 240.6 acres @ \$6 $\frac{1}{2}$ per acre = \$1563.90, the rent;
 275 sheep + 320 sheep + 400 sheep + 495 sheep = 1490 sheep;
 $\frac{275}{1490}$ of \$1563.90 = \$288.64, the rent the first pays;
 $\frac{320}{1490}$ of \$1563.90 = \$335.87, the rent the second pays;
 $\frac{400}{1490}$ of \$1563.90 = \$419.84, the rent the third pays;
 $\frac{495}{1490}$ of \$1563.90 = \$519.55, the rent the fourth pays.
70. An arc of 18° is $\frac{18}{360}$, or $\frac{1}{20}$, of the circumference. Since $\frac{1}{20}$ of the circumference equals $1\frac{1}{4}$ ft., the entire circumference equals 20 times $1\frac{1}{4}$ ft., or 35 ft.; and $35 \text{ ft.} \div 3.1416 = 11.1408+$ ft., the diameter.

52 A KEY TO THE STANDARD ARITHMETIC.

71. Since 9 men can plow 54 acres in 6 days, 1 man can plow 6 acres in 6 days, or 1 acre in a day; it will require 60 men to plow 60 acres in one day, and $\frac{1}{3}$ as many men, or 12 men, to plow 60 acres in 5 days.

72. The shadow of the tree was $27\frac{1}{3}$ times the shadow of the stick; therefore the tree was $27\frac{1}{3}$ times 3 ft. high, or 81 ft. 9.2+ inches.

73. $32 \times 8\frac{1}{2} + 2 = 136$, the number of sq. ft. in one gable.

$136 \times 2 = 272$, the number of sq. ft. in both gables.

74. $12 \text{ ft.} + 8 \text{ ft.} = 20 \text{ ft.}$; $20 + 2 = 10 \text{ ft.}$, the average width;

$(18 \times 10 \times 11) \times 2 = 3960 \text{ cu. ft.}$ in the two abutments;

$3960 \div 24\frac{3}{4} = 160$, the number of perches;

160 perches @ \$2.50 per perch = \$400, the cost.

75. Since C spends $\frac{1}{3}$ of his income and D spends \$65 more than C and is \$10 in debt at the end of a year, and since they have equal incomes, $\frac{1}{3} - \frac{1}{4}$, or $\frac{1}{12}$ of C's income is \$65 - \$10, or \$55; hence C spends 11 times \$55, or \$605, and D spends \$605 + \$65, or \$670.

76. Since the daughter was to receive $\frac{1}{5}$, or $\frac{2}{10}$, of the estate, and the son $\frac{7}{10}$ of it, of every 10 parts of the estate received by both, the daughter would receive 2, and the son 7; or, the daughter's share would be $\frac{2}{10}$, and the son's $\frac{7}{10}$, of the estate.

$\frac{2}{10}$ of \$8000 = \$1600, the daughter's share;

$\frac{7}{10}$ of \$8000 = \$5600, the son's share.

PERCENTAGE.

Page 234.

8. $100\% - 60\% = 40\%$; 40% , or .40, or $\frac{2}{5}$ of 350 cows = 140 cows.
9. $100\% - 33\frac{1}{3}\% = 66\frac{2}{3}\%$;
 $66\frac{2}{3}\%$, or .66 $\frac{2}{3}$, or $\frac{2}{3}$ of 375 acres = 250 acres.
10. $100\% - 16\frac{2}{3}\% = 83\frac{1}{3}\%$; $83\frac{1}{3}\%$, or $\frac{5}{6}$ of 3480 bbl. = 2900 bbl.
11. $100\% - 64\% = 36\%$; 36% , or $\frac{36}{100}$, of 575 sheep = 207 sheep.
12. $67\frac{1}{2}\%$, or .67 $\frac{1}{2}$ of \$900 = \$607.50.

Page 235.

13. $100\% - 37\frac{1}{2}\% = 62\frac{1}{2}\%$; $62\frac{1}{2}\%$, or $\frac{5}{8}$ of 1320 acres = 825 acres.
14. $62\frac{1}{2}\%$, or $\frac{5}{8}$ of 400 = 250, the number of boys.

15. $10\frac{1}{2}\%$, or $.10\frac{1}{2}$ of 375 tons = $39.37\frac{1}{2}$ tons.
16. $100\% - 16\frac{1}{2}\% = 83\frac{1}{2}\%$; $.83\frac{1}{2}$ of \$4750 = \$3966.25.
17. $5\frac{1}{2}\%$, or $.05\frac{1}{2}$ of 42 yd. = 2.31 yd.
18. $100\% - 87\frac{1}{2}\% = 12\frac{1}{2}\%$; $.12\frac{1}{2}$, or $\frac{1}{8}$ of \$1350 = \$168.75.
19. $18\% + 12\frac{1}{2}\% + 34\% = 64\frac{1}{2}\%$, the part invested in stocks, etc.;
 $100\% - 64\frac{1}{2}\% = 35\frac{1}{2}\%$, the part invested in a farm;
 $35\frac{1}{2}\%$, or $.35\frac{1}{2}$ of \$27,000 = \$9585, the cost of the farm.
20. $15\% + 8\frac{1}{2}\% + 16\% = 39\frac{1}{2}\%$, the part he spends;
 $39\frac{1}{2}\%$, or $.39\frac{1}{2}$ of \$1800 = \$708, the amount spent;
 $\$1800 - \$708 = \$1092$, the amount saved.
21. $15\% + 10\% + 10\% + 5\% = 40\%$;
 $100\% - 40\% = 60\%$; 60% of \$150,000 = \$90,000;
 $\$90,000 \div 7 = \$12,857.14\frac{2}{7}$, what each child receives.

Page 236.

14. He sold $\frac{7}{30}$, or .25, or 25% of the flock.

Page 237.

15. He spelled correctly $\frac{3}{4}$, or $\frac{3}{4}$, or 94%.
16. $\frac{40}{275}$, or $\frac{14\frac{6}{11}}{100}$, or $14\frac{6}{11}\%$, of the fruit trees died.
17. He sold 185 bu. which was $\frac{3}{4}$, or $\frac{7}{10}$, or 74% of his crop.
18. He traveled by rail 1365 miles, which was $\frac{1}{5}$, or $\frac{87\frac{1}{2}}{100}$, or $87\frac{1}{2}\%$ of the distance.
19. Since he sold $\frac{1}{3}$ of the sugar, he had $\frac{2}{3}$ of it left. $\frac{1}{3}$ of $\frac{2}{3} = \frac{1}{9}$ the part of the sugar sold at another time. He then had left $\frac{8}{9}$ of the sugar, or $\frac{53\frac{1}{3}}{100}$, or $53\frac{1}{3}\%$ of it.
20. He had 420 bu. left after selling to A. He then sold to B 140 bu. and to C 105 bu., leaving 175 bu. unsold. $175 \div 420 = \frac{5}{12}$, or $\frac{31\frac{1}{4}}{100}$, or $31\frac{1}{4}\%$.
21. $\frac{31}{100} = .31$, or 31% .

54 A KEY TO THE STANDARD ARITHMETIC.

23. He realizes $\frac{1}{3}$, or $5\frac{1}{3}\%$ on his investment.

23. 1% of his indebtedness is \$71.25; hence, \$5765.85 will pay as many per cent of his indebtedness as \$71.25 is contained times in \$5765.85, which is $80\frac{1}{3}$ times. Therefore he can pay $80\frac{1}{3}\%$.

24. He spends 37% of \$4000, which is \$1480, for fuel, etc. $\$4000 - (1480 + 1080) = \1502 . 1% of his money is \$40; hence \$1502 is as many per cent of his money as \$40 is contained times in \$1502, which is $37\frac{1}{2}$ times. Therefore he had $37\frac{1}{2}\%$ left.

Page 239.

23. Since 75% of his crop = 786 bu., 1% of his crop = $\frac{1}{75}$ of 786 bu., or 10.48 bu., and the entire crop = 100 times 10.48 bu., or 1048 bu.

24. Since 25%, or $\frac{1}{4}$, of the goods was sold for \$6650, the entire quantity was worth 4 times \$6650, or \$26,600.

25. 13% of the value of the property = \$520;

1% of the value of the property = \$40;

The value of the property = \$4000.

26. 30% of the crop = 315 bu.; 1% of the crop = 10.5 bu.;

The entire crop = 1050 bu.

27. 84% of his salary = \$1239; 1% of his salary = \$14.75.;

His entire salary = \$1475.

28. $100\% - 65\% = 35\%$, the part of his income saved;

35% of his income = \$420; 1% of his income = \$12.;

His entire income = \$1200.

29. 90% of the cost = \$225; 1% of the cost = \$2.50;

The entire cost = \$250.

30. 17% of the cargo = 289 tons; 1% of the cargo = 17 tons.;

The entire cargo = 1700 tons.

31. $12\frac{1}{2}\%$ of length of road = 14.5 miles; 1% of length = 1.16 miles.;

The entire length = 116 miles.

Page 240.

32. Since \$870 was $33\frac{1}{3}\%$, or $\frac{1}{3}$ of the indebtedness, the total indebtedness was 3 times that amount, or \$2610.

33. $18\frac{1}{4}\%$ of the mixture = $12\frac{1}{4}$ gal.;

1% of the mixture = $\frac{12\frac{1}{4}}{18\frac{1}{4}}$ gal., or .68 gal.;

The entire mixture = 68 gal. ;

Since $12\frac{1}{4}$ gal. of the mixture was water, the remainder, or $55\frac{1}{4}$ gal., was vinegar.

34. $12\frac{1}{2}\%$ of his sales = \$ 185.70 ; 1% of his sales = \$ 14.856;

His entire sales = \$ 1485.60.

35. 1240 bu. = $62\frac{1}{2}\%$, or $\frac{1}{2}$ of the number of bushels raised ;

248 bu. = $\frac{1}{4}$, and 1984 bu. = the entire quantity.

Page 241.

12. Since A has 20% more sheep than B, 120% of B's sheep = 372 ;

1% of B's sheep = 3.1 ; B's sheep = 100 times 3.1, or 310.

13. Since the original salary was increased 15%,

115% of his original salary = \$ 1050 ;

1% of his original salary = \$ 9.13043 ;

His original salary = \$ 913.043.

14. Since the corn was 50% more than the wheat,

150% of the wheat = 750 bu. ; 1% of the wheat = 5 bu. ;

The entire quantity of wheat = 500 bu.

Page 242.

15. Since the cost of the vegetables was $33\frac{1}{3}\%$ more than the cost of the butter and the eggs, $133\frac{1}{3}\%$, or $\frac{4}{3}$ of cost of the butter and the eggs = \$ 36.48 ; $\frac{1}{3}$ of the cost of the butter and the eggs = \$ 9.12 ; the entire cost of the butter and the eggs = \$ 27.36.

16. 100% of the price of the sheep + 165% of the price of the sheep = 265% of the price of the sheep ;

265% of the price received for the sheep = \$ 6105 ;

1% of the price = $\frac{1}{265}$ of \$ 6105, or \$ 23.03773 ;

the entire sum received for the sheep = 100 times \$ 23.03773, or \$ 2303.773 ;

\$ 6105 - \$ 2303.773 = \$ 3801.23, the sum received for the cows.

17. Since the house cost 40% more than the barn,

140% of cost of barn = \$ 2072 ; 1% of cost of barn = \$ 14.80 ;

The cost of the barn = \$ 1480.

18. Since he expended 11% of the cost of the farm for stock,
 111% of the cost of the barn = \$8214;
 1% of the cost of the barn = \$74; the cost of the barn = \$7400.
19. $33\frac{1}{3}\%$ more than $\frac{2}{3}$ of what D raised is $133\frac{1}{3}\%$, or $\frac{4}{3}$ of $\frac{2}{3}$ of what D raised; $\frac{2}{3}$ of $\frac{2}{3} = \frac{4}{9}$. Therefore 496 bu. is $\frac{4}{9}$ of what D raised; consequently he raised 568 bu.
20. $112\frac{1}{2}\%$ of the population three years ago = 8118;
 1% of the population three years ago = 72.16;
 The entire population three years ago = 7216.
21. $137\frac{1}{2}\%$ of the cost = \$1375; 1% of the cost = \$10;
 the cost = \$1000. $\$1000 \div 275 = \$3.63\frac{7}{11}$, the price per head.
22. $117\frac{1}{2}\%$ of the sum F paid = \$7402.50;
 1% of the sum F paid = \$63; the sum F paid = \$6300.

Page 244.

8. Since he spent 25% of his money, he had left 75% of his money, which was \$12.36; 1% of money = \$.1648; his money = 100 times \$.1648, or \$16.48.
9. $100\% - 65\% = 35\%$, the part of his salary left;
 35% of his salary = \$385; 1% of his salary = \$11;
 His entire salary = 100 times \$11, or \$1100.
10. $100\% - 15\% = 85\%$, the part of his wheat left;
 85% of his wheat = 340 bu.;
 1% of his wheat = 4 bu.; the entire quantity = 400 bu.
11. $\$31.20 = 80\%$ of the price asked; 1% of the price asked = \$.39
 and the price asked = 100 times \$.39, or \$39.
12. 60% of his money = \$45.75;
 1% of money = $\frac{1}{100}$ of \$45.75, or \$.4575;
 The entire sum = 100 times \$.4575, or \$45.75.
13. 88% of the December expenses = \$185.68;
 1% of them = $\frac{1}{100}$ of \$185.68, or \$1.8568;
 The entire December expenses = 100 times \$1.8568, or \$185.68.

14. 20% of 85% = 17%, the part of his money which he drew out ;
 85% - 17% = 68%, the part remaining ;
 68% of his money = \$ 3859 ;
 1% of the money = $\frac{1}{85}$ of \$ 3859, or \$ 56.75 ;
 The entire amount = 100 times \$ 56.75, or \$ 5675.
15. 65% of the regiment = 637 men ;
 1% = $\frac{1}{65}$ of 637 men, or 9.8 men ;
 The entire number = 100 times 9.8 men, or 980 men.
16. $66\frac{2}{3}$ % of the real value = \$ 7500 ;
 1% of the real value = $\frac{1}{66\frac{2}{3}}$, or $\frac{3}{200}$ of \$ 7500, or \$ 112.50 ;
 The real value = 100 times \$ 112.50, or \$ 11250.
17. $37\frac{1}{2}$ % of the number of chestnut rails = 1785 ;
 1% of the number of chestnut rails = 47.6 ;
 The number of chestnut rails = 4760 the number of posts.
18. $16\frac{2}{3}$ % of 54% = $\frac{1}{3}$ of 54%, or 9% ; 100% - 9% = 91% ;
 91% of Tuesday's sales = \$ 385.84 ;
 1% of Tuesday's sales = \$ 4.24 ;
 The amount of Tuesday's sales = \$ 424.

PROFIT AND LOSS.

Page 245.

2. Since the sugar cost 5¢ per lb., to gain 20%, or $\frac{1}{5}$, of the cost, 1¢ per lb. must be gained. Therefore it must be sold at 6¢ per lb.
3. Since the goods cost him 25¢ per yd., and were sold at a loss of 10%, or $\frac{1}{10}$, of the cost, the loss was 2½¢ per yd. Therefore the selling price was 22½¢.
4. Since there was a gain of \$ 1 on an investment of \$ 4, the gain was $\frac{1}{4}$, or 25%, of the cost.
5. Since the gain is 5¢ on what cost 20¢, the gain is $\frac{1}{4}$ of the cost, or 25% of the cost.
6. Since there was a loss of 20¢ on what cost 60¢, the loss was $\frac{1}{3}$ of the cost, or $33\frac{1}{3}$ % of the cost.

7. Since there was a loss of \$2 upon what cost \$6, the loss was $\frac{1}{3}$ of the cost, or $33\frac{1}{3}\%$ of the cost.

8. Since the 5¢ gained was 25%, or $\frac{1}{4}$, of the cost, the cost must have been 4 times 5¢, or 20¢.

9. Since the 4¢ lost per yard was 20%, or $\frac{1}{5}$, of the cost, the cost must have been 5 times 4¢, or 20¢.

10. Since the 8¢ advance was 10%, or $\frac{1}{10}$, of the cost, the cost must have been 10 times 8¢, or 80¢.

11. Since the 25¢ lost per copy was $12\frac{1}{2}\%$, or $\frac{1}{8}$, of the cost, the cost must have been 8 times 25¢, or \$2.00.

12. Since \$75 was 25%, or $\frac{1}{4}$, of the cost, the cost must have been 4 times \$75, or \$300.

13. Since the gain of 80¢ per bbl. was $12\frac{1}{2}\%$, or $\frac{1}{8}$, of the cost, the cost must have been 8 times 80¢, or \$6.40.

Page 246.

14. Since the gain of 6¢ per lb. was 20%, or $\frac{1}{5}$, of the cost, the cost must have been 5 times 6¢, or 30¢, per lb.

16. Since 10%, or $\frac{1}{10}$, of the cost was lost, the selling price was but $\frac{9}{10}$ of the cost. Therefore $\frac{9}{10}$ of the cost was 90¢.

Since $\frac{9}{10}$ of the cost was 90¢, $\frac{1}{10}$ of the cost was $\frac{1}{10}$ of 90¢, or 10¢, and the cost was 10 times 10¢, or \$1.00.

17. Since he made a profit of 40% of the cost, the selling price must have been 140% of the cost. Therefore 140%, or $1\frac{2}{5}$, of the cost was \$140; 1%, or $\frac{1}{100}$, of the cost \$1; and the cost 100 times \$1, or \$100.

18. Since the gain was 25% of the cost, the selling price must have been 125% of the cost. Therefore 125% of the cost was \$1.25, 1% of the cost \$.01, and 100% of the cost, or the cost, \$1.

19. Since the profit was $33\frac{1}{3}\%$, or $\frac{1}{3}$, of the cost, the selling price must have been $\frac{4}{3}$ of the cost. Therefore $\frac{4}{3}$ of the cost was \$24, $\frac{1}{3}$ of the cost \$6, and the cost 3 times \$6, or \$18.

20. Since the merchant gained 25%, or $\frac{1}{4}$, of the cost, the boy must have paid $\frac{3}{4}$ of the cost. Therefore $\frac{3}{4}$ of the cost was \$2.50, $\frac{1}{4}$ of the cost \$.50, and the cost 4 times \$.50, or \$2.

21. Since the coat was sold at a loss of $16\frac{2}{3}\%$, or $\frac{1}{3}$, of the cost, the price received for it was but $\frac{2}{3}$ of the cost. Therefore $\frac{2}{3}$ of the cost was \$15, $\frac{1}{3}$ of the cost \$3, and the cost \$18.

22. Since the profit was 25%, or $\frac{1}{4}$, of the cost, \$25 was $\frac{1}{4}$ of the cost, and the cost was \$100.

23. Since the clothier gained \$5 upon an investment of \$20, he gained $\frac{1}{4}$ of the cost, or 25% of the cost.

24. If \$10 profit per head was 25%, or $\frac{1}{4}$, of the cost, then the cattle cost 4 times \$10, or \$40, per head.

25. Since he wishes to increase the cost price $33\frac{1}{3}\%$, or $\frac{1}{3}$, he must get $\frac{4}{3}$ of the cost. $\frac{2}{3}$ of \$15 is \$20, the selling price.

26. Since the furniture was sold at a loss of $12\frac{1}{2}\%$, or $\frac{1}{8}$, of the cost, the loss must have been $\frac{1}{8}$ of \$80, or \$10. \$80 - \$10 = \$70, the selling price.

Page 247.

1. Since he gained 15¢ on every dollar invested, he gained on \$48.93, 48.93 times 15¢, or \$7.3395.

2. \$350 \times 1.20 = \$420, amount received.

3. \$2460 \times .25 = \$615, gained.

4. \$4675 \times .08 = \$374, gain.

5. \$215 \times 1.40 = \$301, selling price.

6. \$1890 \times .16 $\frac{2}{3}$ = \$315, loss.

7. \$3600 \times 1.18 = \$4248, amount received.

8. \$2180 \times 1.33 $\frac{1}{3}$, or 1 $\frac{1}{3}$ = \$2906 $\frac{2}{3}$, amount received.

9. \$115,000 \times (1.00 - .12 $\frac{1}{2}$) = \$100,625, amount received.

10. 1260 lb. sugar @ 4 $\frac{1}{2}$ ¢ = \$53.55 ;

\$53.55 \times 1.10 = \$58.905, what I received for sugar.

11. 2360 bu. @ 85¢ = \$2006 ;

\$2006 \times 1.18 $\frac{1}{3}$ = \$2382.125, the sum received.

Page 248.

13. \$4.95 - \$4.50 = \$.45, the gain ; therefore the gain was $\frac{15}{100}$, or 15%, of his investment.

14. \$3680 - \$3200 = \$480 ; \$480 \div \$3200 = .15, or 15% increase.

15. \$3000 - \$2400 = \$600 ; \$600 \div \$2400 = 25% gain.

16. \$780 - \$650 = \$130 ; \$130 \div \$650 = 20% gain.

17. 350 yd. @ \$1.12 $\frac{1}{2}$ = \$393.75 ; \$131.25 \div \$393.75 = 33 $\frac{1}{3}$ % gain.

60 A KEY TO THE STANDARD ARITHMETIC.

18. The merchant paid but 80% of the market value; and since he sold at an advance of 20% above their market value, he gained 40% of the market value on an investment of 80% of the market value, or $\frac{4}{5}\%$, or 50% of the cost.

19. $\$194 - \$145.50 = \$48.50$; $\$48.50 \div \$145.50 = 33\frac{1}{2}\%$, gain.

20. $\$9375 - \$7500 = \$1875$; $\$1875 \div \$7500 = 25\%$, gain.

21. 60% of $\$6450 = \3870 , the sum spent on improvements;

$\$3870 + \$6450 = \$10,320$, the total cost;

$\$11,868 - \$10,320 = \$1548$, the gain;

$\$1548 \div \$10,320 = 15\%$, the per cent gained.

22. 40%, or .40, or $\frac{2}{5}$, of cost = $\$20$; $\frac{1}{2}$ of cost = $\$10$;

The cost = $\$50$.

24. $\$3.60$ was 20% of the cost; 1% of the cost was $\$.18$;

The cost was $\$18$.

Page 249.

25. $\$.28 \div .25 = \1.12 , the cost per yd.

26. $\$250 \div .12\frac{1}{2} = \2000 , the cost.

27. $\$1.12 \div .08 = \14 , the cost; $\$14 + 56 = 25\%$, the cost per lb.

28. $\$11.25 \div .15 = \75 , the cost per acre.

29. $\$538 \div .16\frac{2}{3} = \3228 , the cost. 31. $\$1650 \div .37\frac{1}{2} = \4400 .

30. $\$918.75 \div .21 = \4375 , the cost. 32. $\$3650 \div .20 = \$18,250$.

35. The selling price = 125% of the cost; 125% of the cost = $\$44.50$;

1% of the cost = $\$.356$; the cost = $\$35.60$.

Page 250.

36. The selling price = 112% of the cost;

112% of the cost = $\$1260$; 1% of the cost = $\$11.25$;

The cost = $\$1125$.

37. $110\frac{1}{2}\%$ of the cost = $\$235$; 1% of the cost = $\$2.12669+$;

The cost = $\$212.669+$.

38. 120% of cost = $\$136.44$; 1% of cost = $\$1.137$;

The cost = $\$113.70$.

39. 95% of cost = $\$361$; 1% of cost = $\$3.80$. The cost = $\$380$.

40. $\$980.28 \div .90 = \1089.20 , the cost.

41. $\$4527 + .06\frac{1}{2} = \4790.50 , the cost.
42. $\$4575 + .965 = \4740.9325 , the cost.
43. $\$2.00 \times .87\frac{1}{2} = \1.75 , the cost ; $\$2.00 - \$1.75 = \$.25$, the gain ;
 $\$.25 \div \$1.75 = 14\frac{2}{7}\%$, the gain.
44. 80 acres at $\$50$ per acre = $\$4000$;
 $\$4000 + \$1800 = \$5800$, the entire cost ;
 $\$5800 \times 1.15 = \6670 , the selling price to gain 15% ;
 $\$6670 \div 80 = \83.375 , the selling price per acre.
45. $\$1.00$ per yd. = 80% of the marked price ;
the marked price = $\$1 \div .80$, or $\$1.25$, per yd. ;
 $\$1.25 = 125\%$ of cost ; the cost = $\$1.25 \div 1.25$, or $\$1.00$, per yd.
46. $\$3600 \div 1.25 = \2880 , the cost of one ;
 $\$3600 \div .75 = \4800 , the cost of the other ;
 $\$4800 + \$2880 = \$7680$, the cost of both ;
 $\$3600 \times 2 = \7200 , what he received for both ;
 $\$7680 - \$7200 = \$480$, the loss.
47. Since coal is bought by the long ton of 2240 lb., and sold by the short ton of 2000 lb., 240 lb. is gained on each ton sold, or $\frac{240}{2000}$, of the cost, or $\frac{12}{100}$, or 12%.

COMMISSION.

Page 252.

3. $3\frac{1}{2}\%$ of $\$1260 = \44.10 , the commission.
4. 680 bu. @ $\$1.10 = \748 ; $2\frac{1}{4}\%$ of $\$748 = \18.70 , the commission.
5. 95% of $\$3450 = \3277.50 , the sum remitted.
6. 5% of the sum collected = $\$375$;
1% of the sum collected = $\$75$; the sum collected = $\$7500$.
7. $\$7415 \div 1.02 = \7269.607 , the sum spent for wheat ;
 $\$7269.607 \div \$.85 = 8552$ bu. 1 pk. 7.3 qt. +.
8. 585 bbl. @ $\$4.50 = \2632.50 ;
 $2\frac{1}{2}\%$ of $\$2632.50 = \$65.81\frac{1}{2}$, the commission ;
 $\$2632.50 + \$65.81\frac{1}{2} = \$2698.31\frac{1}{2}$, the sum remitted.

Page 253.

9. $3\frac{1}{4}\%$ of \$4800 = \$156; \$4800 - \$156 = \$4644;
 \$4644 - \$25 = \$4619, the sum left after paying the commission
 and charges;
 $\$4619 \div 1.025 = \$4506.341+$, the sum invested.
10. $\$14,616 \div 1.015 = \$14,400$, the amount spent in wheat;
 $\$14,400 \div \$.90 = 16,000$, the number of bu. purchased.
11. 80% of \$2360 = \$1888; 5% of \$1888 = \$94.40;
 $\$1888 - \$94.40 = \$1793.60$, the sum the creditor received.
12. $\$3536.25 \div 1.025 = \3450 , the sum spent in cotton.
13. $\$100 - \$10.40 = \$89.60$, the agent's commission;
 $\$89.60 \div \$2560 = 3\frac{1}{2}\%$, the rate per cent.

COMMERCIAL DISCOUNT.

Page 254.

11. $\$320 - 35\%$ of \$320 = \$208.00;
 $\$320 - 20\%$ of \$320 = \$256.00; $\$256 - 15\%$ of \$256 = \$217.60;
 $\$217.60 - \$208 = \$9.60$, the difference in favor of direct discount.
12. $\$60.80 - 30\%$ of \$60.80 = \$42.56;
 $\$42.56 - 10\%$ of \$42.56 = \$38.304.
13. $\$345 \times .92 = \317.40 ; $\$317.40 \times .95 = \301.53 .
14. $\$420.65 - 25\%$ of \$420.65 = \$315.48 $\frac{1}{2}$;
 $\$315.48\frac{1}{2} - 10\%$ of \$315.48 $\frac{1}{2}$ = \$283.93 $\frac{1}{4}$.
15. $\$230 - 45\%$ of \$230 = \$126.50;
 $\$230 - 25\%$ of \$230 = \$172.50;
 $\$172.50 - 15\%$ of \$172.50 = \$146.625;
 $\$146.625 - 5\%$ of \$146.625 = \$139.293+;
 $\$139.293 - \$126.50 = \$12.793+$, the difference in favor of direct
 discount.
16. $\$450 \times .70 = \315 ; $\$315 \times .90 = \283.50 ;
 $\$283.50 \times .95 = \269.325 .
17. $\$360 \times .87\frac{1}{2} = \315 ; $\$315 \times .92 = \289.80 , the net amount;
 $\$360 - 289.80 = \70.20 ; $\$70.20 \div 360 = 19\frac{1}{2}\%$, the single discount.

TAXES.

Page 257.

3. Tax by table on \$ 5000 = \$ 41.05
 Tax by table on 700 = 5.747
 Tax by table on 80 = .6568

 Tax by table on \$ 5780 = \$ 47.4538
4. Tax by table on \$ 6000 = \$ 49.26
 Tax by table on 6000 = 49.26
 Tax by table on 600 = 4.926
 Tax by table on 50 = .4105

 Tax by table on \$ 12650 = \$ 103.8565
 Poll tax = 2.00

 \$ 105.8565, the entire tax.
5. \$ 6759 \times .00821 = \$ 55.49, his property tax ;
 3.00, his poll tax.

 \$ 58.49, his entire tax.
6. Tax on \$ 9000 = \$ 73.89
 Tax on 4000 = 32.84
 Tax on 400 = 3.284
 Tax on 10 = .0821
 Tax on 7 = .05747
 Tax on .40 = .00328

 Tax on \$ 13417.40 = \$ 110.15685.
7. 390 polls @ \$ 1 each = \$ 390 ;
 \$ 5822.24 - \$ 390 = \$ 5432.24, the tax on property ;
 \$ 5432.24 \div \$ 987,680 = .0055, the rate.
8. \$ 19.430 \times 9.50 = \$ 184.585, the property tax ;
 1.25 , the poll tax.

 \$ 185.835, the entire tax.
9. \$ 8840 \div \$ 1,360,000 = .0065, the rate.

64 A KEY TO THE STANDARD ARITHMETIC.

10. $\$3150 \times .0065 = \20.475 , A's tax;
 $\$4200 \times .0065 = \27.30 , B's tax.;
 $\$5595 \times .0065 = \36.3675 , C's tax.
11. $\$48.15 \div .0075 = \6420 , the assessed value.

DUTIES OR CUSTOMS.

Page 258.

1. $420 \text{ yd. @ } \$1.75 \text{ per yd.} = \735.00 , the value of the cloth;
 $\$735.00 \times .25 = \183.75 , the duty.
2. $2800 \text{ lb.} \times .05 = 140 \text{ lb.}$, the tare;
 $2800 \text{ lb.} - 140 \text{ lb.} = 2660 \text{ lb.}$, the net weight;
 $2660 \text{ lb. @ } 2\frac{1}{4}\text{¢ per lb.} = \59.85 , the duty.
3. $\$4.8665 \times 530\frac{1}{2} = \$2580.4616+$;
 $\$2580.4616 \times .45 = \1161.207 , the duty.
4. $\$638.24 \times .40 = \255.296 , the duty;
 $\$638.24 + \$255.296 = \$893.536$, the entire cost;
 $\$893.536 \div 72 = \12.41 , the cost per dozen.
5. $1560 \text{ yd. @ } 38\text{¢} = \592.80 , the cost;
 $\$592.80 \times .35 = \207.48 , the duty.
6. $60 \text{ lb.} \times 280 = 16,800 \text{ lb.}$;
 $16,800 \text{ lb. @ } 45\text{¢ per lb.} = \7560.00 , the invoiced price;
 $\$7560.00 \times .25 = \1890 , the duty.
7. $24 \text{ lb.} - 5\frac{1}{2} \text{ lb.} = 18\frac{1}{2} \text{ lb.}$, the net weight of each box;
 $18\frac{1}{2} \text{ lb.} \times 36 = 666 \text{ lb.}$, the net weight of the raisins;
 $666 \text{ lb. @ } 2\frac{1}{2}\text{¢ per lb.} = \16.65 , the duty.
8. $2240 \text{ lb.} \times 45 = 100,800 \text{ lb.}$, the weight of steel;
 $100,800 \text{ lb. @ } 5\frac{1}{2}\text{¢ per lb.} = \5544.00 , the invoiced price;
 $\$5544.00 \times .33\frac{1}{3} = \1848 , the duty.
9. $\$1.50 \times 80 = \120 , the invoiced price; $\$120 \times .05 = \6 , the breakage;
 $\$120 - \$6 = \$114$, the net value; $\$114 \times .25 = \28.50 , the duty.

10. 60 yd. \times 18 = 1080 yd. ;
 1080 yd. @ 45¢ per yd. = \$ 486, the invoiced price ;
 \$ 486 \times .35 = \$ 170.10, the ad valorem duty ;
 1080 yd. @ 38¢ = \$ 410.40, the specific duty ;
 \$ 170.10 + \$ 410.40 = \$ 580.50, the entire duty.
11. 320 lb. @ 35¢ = \$ 112, the specific duty on knit goods ;
 \$ 1225 \times .40 = \$ 490, the ad valorem duty ;
 120 yd. @ \$ 1.25 = \$ 150, the invoiced price of silk ;
 \$ 150 \times .50 = \$ 75, the ad valorem duty on silk ;
 500 yd. @ 87½¢ = \$ 437.50, the invoiced price of lace ;
 \$ 437.50 \times .40 = \$ 175, the ad valorem duty on lace ;
 \$ 490 + \$ 112 + \$ 75 + \$ 175 = \$ 852, the entire duty.

PROPERTY INSURANCE.

Page 260.

1. \$ 8500 \times .02½ = \$ 233.75, the premium.
2. \$ 3600 \times .01½ = \$ 54, the premium.
3. ¾ of \$ 45,000 = \$ 30,000, the sum insured.
 \$ 30,000 \times .01½ = \$ 525.00, the premium.
4. \$ 5800 \times 7 = \$ 40,600, the sum insured ;
 \$ 40,600 \times .01½ = \$ 710.50, the premium.
5. \$ 75 + \$ 6400 = .01½½, or 1½½%, the rate.
6. ⅓ of \$ 9670 = \$ 8703 ; \$ 8703 \times .03½ = \$ 304.605, the premium.

The owner lost ⅓ of the value of the cargo, or \$ 967, and the premium, \$ 304.605, or his entire loss was \$ 1271.605.

7. ¾ of \$ 9840 = \$ 6560, the sum insured ;
 \$ 6560 \times .007 = \$ 57.40, the premium.
8. \$ 375 \div .0125 = \$ 30,000, the amount of insurance.
9. \$ 3493.50 \div 1.0275 = \$ 3400, the sum invested in flour ;
 \$ 3400 \div \$ 4.25 = 800, the number of barrels of flour ;
 \$ 3400 \times .01½ = \$ 38.25, the premium for insuring flour ;
 \$ 3493.50 + \$ 268.25 + \$ 38.25 = \$ 3800, the entire cost ;
 \$ 3800 \times 1.10 = \$ 4180, the selling price to gain 10% ;
 \$ 4180 \div 800 = \$ 5.225, the selling price per barrel.

PERSONAL INSURANCE.

Page 261.

1. $\$25.70 \times 4 = \102.80 , the annual premium per $\$1000$.
2. $\$6500 = 6.5$ thousands ;
Therefore $\$29.50 \times 6.5 = \191.75 , the annual premium.
3. $\$26.30 \times 3 = \78.90 , the annual premium ;
 $\$78.90 \times 30 = \2367.00 , the amount of premiums ;
 15% of $\$2367 = \355.05 , the dividends returned ;
 $\$2367 - \$355.05 = \$2011.95$, the sum paid.
4. $\$315 \div 9 = \35 , the premium per $\$1000$.
5. $\$31.40 \times 6 = \188.40 , the annual premium ;
 $\$188.40 \times 12 = \2260.80 , the total premiums ;
 $\$6000 - \$2260.80 = \$3739.20$, more.
6. $\$26.30 \times 8 \times 20 = \4208 , the sum paid.
7. $\$172.50 - \$1 = \$171.50$;
 $\$171.50 \div 5 = \34.30 , the premium per $\$1000$.

INTEREST.

Page 263.

11. $\$687.35 \times .06 = \41.241 , interest for 1 yr.
 $\$41.241 \times 3 = \123.723 , interest for 3 yr. ;
 $\frac{1}{2}$ of interest for 1 yr. = $\frac{20.62}{}$, interest for 6 mo.
 $\$144.343$, interest for 3 yr. 6 mo.
12. $\$476.38 \times .06 = \28.5828 , interest for 1 yr.
 $\$28.5828 \times 4 = \114.3312 , interest for 4 yr. ;
 $\frac{1}{2}$ of the interest for 1 yr. = $\frac{19.0552}{}$, interest for 8 mo.
 $\$133.3864$, interest for 4 yr. 8 mo.
13. $\$380.40 \times .07 = \26.628 , interest for 1 yr.
 $\$26.628 \times 4 = \106.512 , interest for 4 yr. ;
 $\frac{1}{2}$ of interest for 1 yr. = $\frac{8.76}{}$, interest for 4 mo. ;
 $\frac{1}{4}$ of interest for 4 mo. = $\frac{2.219}{}$, interest for 1 mo.
 $\$117.607$, interest for 4 yr. 5 mo.

14. $\$425.60 \times .05 = \21.28 , interest for 1 yr.
 $\$21.28 \times 5 = \106.40 , interest for 5 yr.;
 $\frac{1}{2}$ of interest for 1 yr. = 10.64 , interest for 6 mo.;
 $\frac{1}{3}$ of interest for 6 mo. = 1.773 , interest for 1 mo.

 $\$118.813$, interest for 5 yr. 7 mo.

15. $\$368.52 \times .09 = \33.1668 , interest for 1 yr.
 $\$33.1668 \times 6 = \199.0008 , interest for 6 yr.;
 $\frac{1}{3}$ of interest for 1 yr. = 11.0556 , interest for 4 mo.

 $\$210.0564$, interest for 6 yr. 4 mo.

16. $\$410.30 \times .07 = \28.721 , interest for 1 yr
 $\$28.721 \times 7 = \201.047 , interest for 7 yr.;
 $\frac{1}{2}$ of interest for 1 yr. = 7.18 , interest for 3 mo.

 $\$208.227$, interest for 7 yr. 3 mo.

Page 264.

23. $\$313.50 \times .06 = \18.81 , interest for 1 yr.
 $\$18.81 \times 2 = \37.62 , interest for 2 yr.;
 $\frac{1}{2}$ of interest for 1 yr. = 4.70 , interest for 3 mo.

 $\$42.32$, interest for 2 yr. 3 mo.
 313.50 , principal.

 $\$355.82$, amount.

29. $\$935.75 \times .07 = \65.5025 , interest for 1 yr.
 $\$65.5025 \times 3 = 196.5075$, interest for 3 yr.;
 $\frac{1}{2}$ of interest for 1 yr. = 21.834 , interest for 4 mo.;
 $\frac{1}{4}$ of interest for 4 mo. = 5.4585 , interest for 1 mo.

 $\$223.80$, interest for 3 yr. 5 mo.;
 935.75 , principal.

 $\$1159.55$, amount.

Page 265.

30. $\$269.50 \times .05 = \13.475 , interest for 1 yr.;
 $\frac{1}{2}$
 $\$26.95$, interest for 2 yr.;
 $\frac{1}{4}$ of interest for 1 yr. = 6.7375 , interest for 6 mo.;
 $\frac{1}{6}$ of interest for 6 mo. = 1.1229 , interest for 1 mo.;
 $\frac{1}{10}$ of interest for 1 mo. = $.3743$, interest for 10 da.
 $\$35.18$, interest for 2 yr. 7 mo. 10 da.;
 269.50 , principal,
 $\$304.68$, amount.
31. $\$468.75 \times .07 = \32.8125 , interest for 1 yr.;
 $\frac{1}{4}$ of interest for 1 yr. = 10.937 , interest for 4 mo.;
 $\frac{1}{2}$ of interest for 4 mo. = 2.734 , interest for 1 mo.;
 $\frac{1}{15}$ of interest for 1 mo. = 1.367 , interest for 15 da.
 $\$47.85$, interest for 1 yr. 5 mo. 15 da.;
 468.75 , principal.
 $\$516.60$, amount.
32. $\$274.08 \times .06 = \16.4448 , interest for 1 yr.;
 $\frac{1}{2}$
 $\$32.8896$, interest for 2 yr.;
 $\frac{1}{6}$ of interest for 1 yr. = 8.2224 , interest for 6 mo.;
 $\frac{1}{6}$ of interest for 6 mo. = 1.3704 , interest for 1 mo.;
 $\frac{1}{5}$ of interest for 1 mo. = $.2284$, interest for 5 da.
 $\$42.71$, interest for 2 yr. 7 mo. 5 da.;
 274.08 , principal.
 $\$316.79$, amount.
33. $\$364.50 \times .05 = \18.225 , interest for 1 yr.;
 $\frac{1}{2}$
 $\$36.45$, interest for 2 yr.;
 $\frac{1}{6}$ of interest for 1 yr. = 9.112 , interest for 6 mo.;
 $\frac{1}{2}$ of interest for 6 mo. = 3.037 , interest for 2 mo.;
 $\frac{1}{20}$ of interest for 2 mo. = 1.012 , interest for 20 da.
 $\$49.61$, interest for 2 yr. 8 mo. 20 da.;
 364.50 , principal.
 $\$414.11$, amount.

Page 266.

2. The interest of \$ 1 for 2 yr. = \$.12

The interest of \$ 1 for 2 mo. = .01

The interest of \$ 1 for 6 da. = .001

The interest of \$ 1 for 2 yr. 2 mo. 6 da. = \$.131

The interest of \$ 575.40 = \$.131 \times 575.40, or \$ 75.38.

3. The interest of \$ 1 for 3 yr. = \$.18

The interest of \$ 1 for 4 mo. = .02

The interest of \$ 1 for 18 da. = .003

The interest of \$ 1 for 3 yr. 4 mo. 18 da. = \$.203

The interest of \$ 434.70 = \$.203 \times 434.70, or \$ 88.24.

4. The interest of \$ 1 for 2 yr. = \$.12

The interest of \$ 1 for 6 mo. = .03

The interest of \$ 1 for 12 da. = .002

The interest of \$ 1 for 2 yr. 6 mo. 12 da. = \$.152

The interest of \$ 387.62 = \$.152 \times 387.62, or \$ 58.92.

5. The interest of \$ 1 for 3 yr. = \$.18

The interest of \$ 1 for 8 mo. = .04

The interest of \$ 1 for 24 da. = \$.004

The interest of \$ 1 for 3 yr. 8 mo. 24 da. = \$.224

The interest of \$ 292.47 = \$.224 \times 292.47, or \$ 65.51.

6. The interest of \$ 1 for 4 yr. = \$.24

The interest of \$ 1 for 7 mo. = .035

The interest of \$ 1 for 15 da. = .0025

The interest of \$ 1 for 4 yr. 7 mo. 15 da. = \$.2775

The interest of \$ 436.45 = \$.2775 \times 436.45, or \$ 121.11.

7. The interest of \$ 1 for 1 yr. = \$.06

The interest of \$ 1 for 9 mo. = .045

The interest of \$ 1 for 21 da. = .0035

The interest of \$ 1 for 1 yr. 9 mo. 21 da. = \$.1085

The interest of \$ 672.36 = \$.1085 \times 672.36, or \$ 72.95.

8. The interest of \$ 1 for 3 yr. = \$.18
 The interest of \$ 1 for 4 mo. = .02
 The interest of \$ 1 for 18 da. = .003

The interest of \$ 1 for 3 yr. 4 mo. 18 da. = \$.203

The interest of \$ 945.50 = \$.203 × 945.50, or \$ 191.94.

9. The interest of \$ 1 for 5 yr. = \$.30
 The interest of \$ 1 for 7 mo. = .035
 The interest of \$ 1 for 24 da. = .004

The interest of \$ 1 for 5 yr. 7 mo. 24 da. = \$.339

The interest of \$ 392 = \$.339 × 392, or \$ 132.89.

Page 267.

10. Interest on \$ 1 at 6% for 3 yr. 2 mo. 12 da. = \$.192 ;
 interest on \$ 1 at 1% for 3 yr. 2 mo. 12 da. = .032 ;
 interest on \$ 1 at 7% for 3 yr. 2 mo. 12 da. = .224 ;
 the interest of \$ 280.75 = \$.224 × 280.75, or \$ 62.89.
11. Interest of \$ 1 for 5 yr. 7 mo. 18 da. @ 6% = \$.338 ;
 interest of \$ 1 for 5 yr. 7 mo. 18 da. @ 1% = .056½ ;
 interest of \$ 1 for 5 yr. 7 mo. 18 da. @ 8% = .450½ ;
 the interest of \$ 315.40 = \$.450½ × 315.40, or \$ 142.14.
12. Interest on \$ 1 @ 6% = \$.5275 ; interest on \$ 1 @ 1% = \$.0879½ ;
 interest on \$ 1 @ 5% = \$.4395½ ; \$.4395½ × 416.26 = \$ 182.98.
13. Interest on \$ 1 @ 6% = \$.448½ ; interest on \$ 1 @ 3% = \$.224½ ;
 interest on \$ 1 @ 9% = \$.672½ ; \$.672½ × 620.35 = \$ 417.03.
14. Interest @ 6% = \$.577½ ; interest @ 1% = \$.096⅞ ;
 interest @ 4% = \$.384⅞ ; \$.384⅞ × 575.38 = \$ 221.39.
2. Time, 65 da. ; the interest of \$ 1 for 65 da. @ 6% is \$.010½ ;
 \$.010½ × 840 = \$ 9.10.
3. Time, 71 da. ; the interest of \$ 1 for 71 da. @ 6% is \$.011½ ;
 \$.011½ × 950 = \$ 11.24.
4. Time, 134 da. ; the interest of \$ 1 for 134 da. @ 6% is \$.022½ ;
 \$.022½ × 879 = \$ 19.63.

5. Time, 151 da.; the interest of \$1 for 151 da. @ 6% is \$.025 $\frac{1}{2}$;
\$.025 $\frac{1}{2}$ \times 895 = \$22.52.
6. Time, 138 da.; the interest of \$1 for 138 da. @ 6% is \$.023;
\$.023 \times 965 = \$22.195.
7. Time, 112 da.; the interest of \$1 for 112 da. @ 6% is \$.018 $\frac{2}{3}$;
\$.018 $\frac{2}{3}$ \times 1050 = \$19.80.
8. Time, 67 da.; the interest of \$1 for 67 da. @ 6% is \$.011 $\frac{1}{2}$;
\$.011 $\frac{1}{2}$ \times 1120 = \$12.51.
9. Time, 219 da.; the interest of \$1 for 219 da. @ 6% is \$.036 $\frac{1}{2}$;
\$.036 $\frac{1}{2}$ \times 3000 = \$109.50.

Page 268.

2. Interest of \$270.60 for 1 yr. @ 7% is \$18.942;
interest of \$270.60 for 1 mo. @ 7% is \$1.5785;
1 yr. 2 mo. 15 da. = 14.5 mo.; \$1.5785 \times 14.5 = \$22.89.
3. Interest of \$285.45 for 1 yr. @ 5% is \$14.2725;
interest of \$285.45 for 1 mo. @ 5% is \$1.189375;
3 yr. 4 mo. 20 da. = 40.6 $\frac{2}{3}$ mo.; \$1.189375 \times 40.6 $\frac{2}{3}$ = 48.36.
4. Interest of \$315.65 for 1 yr. @ 6% is \$18.939;
interest of \$315.65 for 1 mo. @ 6% is \$1.578 $\frac{1}{2}$;
2 yr. 3 mo. 10 da. = 27 $\frac{1}{3}$ mo.; \$1.578 $\frac{1}{2}$ \times 27 $\frac{1}{3}$ = \$43.14.
5. Interest of \$573.95 for 1 yr. @ 8% is \$45.916;
interest of \$573.95 for 1 mo. @ 8% is \$3.826 $\frac{1}{3}$;
6 yr. 5 mo. 24 da. = 77.8 mo.; \$3.826 $\frac{1}{3}$ \times 77.8 = \$297.69.
6. Interest of \$397.85 for 1 yr. @ 6% is \$23.871;
interest of \$397.85 for 1 mo. @ 6% is \$1.9892 $\frac{1}{2}$;
2 yr. 3 mo. 5 da. = 27.1 $\frac{2}{3}$ mo.; \$1.9892 \times 27.1 $\frac{2}{3}$ = \$54.04.
7. Interest of \$463.28 for 1 yr. @ 7% is \$32.4296;
interest of \$463.28 for 1 mo. @ 7% is \$2.7024;
1 yr. 2 mo. 7 da. = 14.2 $\frac{1}{3}$ mo.; \$2.7024 \times 14.2 $\frac{1}{3}$ = \$38.46.
8. Interest of \$395.18 for 1 yr. @ 5% is \$19.759;
interest of \$395.18 for 1 mo. @ 5% is \$1.64658;
3 yr. 4 mo. 8 da. = 40.3 $\frac{2}{3}$ mo.; \$1.64658 \times 40.3 $\frac{2}{3}$ = \$66.30.

9. Interest of \$793.64 for 1 yr. @ 4% is \$31.745 ;
 interest of \$793.64 for 1 mo. @ 4% is \$2.6454 ;
 5 yr. 6 mo. 9 da. = 66.3 mo. ; $\$2.6454 \times 66.3 = \175.39 .

ANNUAL INTEREST.

Page 269.

2. Interest of \$1200 for 3 yr. 4 mo. @ 6% = \$240 ;
 interest of \$1200 for 1 yr. @ 6% = \$72 ;
 interest of \$72 for $2\frac{1}{2}$ yr. + $1\frac{1}{2}$ yr. + $\frac{1}{2}$ yr., or 4 yr. = \$17.28 ;
 $\$1200 + \$240 + \$17.28 = \1457.28 , the amount due.
3. Interest of \$1420 for 4 yr. 6 mo. @ 6% = \$383.40 ;
 interest of \$1420 for 1 yr. @ 6% = \$85.20 ;
 interest of \$85.20 for $3\frac{1}{2}$ yr. + $2\frac{1}{2}$ yr. + $1\frac{1}{2}$ yr. + $\frac{1}{2}$ yr. = \$40.90 ;
 $\$1420 + \$383.40 + \$40.90 = \1844.30 , the amount due.
4. Interest of \$1825 for 5 yr. 8 mo. @ 7% = \$723.92 ;
 interest of \$1825 for 1 yr. @ 7% = \$127.75 ;
 interest of \$127.75 for $4\frac{2}{3}$ yr. + $3\frac{2}{3}$ yr. + $2\frac{2}{3}$ yr. + $1\frac{2}{3}$ yr. + $\frac{2}{3}$ yr.,
 or $18\frac{1}{3}$ yr. = \$119.23 ;
 $\$1825 + \$723.92 + \$119.23 = \2668.15 , the amount due.
5. Interest of \$1976 for 3 yr. 6 mo. 12 da. @ 6% = \$418.91 ;
 interest of \$1976 for 1 yr. @ 6% = \$118.56 ;
 interest of \$118.56 for 2 yr. 6 mo. 12 da. + 1 yr. 6 mo. 12 da.
 + 6 mo. 12 da., or 4 yr. 7 mo. 6 da. = \$32.72 ;
 $\$1976 + \$418.91 + \$32.72 = \2427.63 , the amount due.
6. Interest of \$2300 for 3 yr. 5 mo. 18 da. @ 8% = \$637.87 ;
 interest of \$2300 for 1 yr. @ 8% = \$184 ;
 interest of \$184 for 2 yr. 5 mo. 18 da. + 1 yr. 5 mo. 18 da.
 + 5 mo. 18 da., or 4 yr. 4 mo. 24 da. = \$64.76 ;
 $\$2300 + \$637.87 + \$64.76 = \3002.63 , the amount due.
7. Interest of \$2760 for 5 yr. 3 mo. 6 da. @ 5% = \$726.80 ;
 interest of \$2760 for 1 yr. @ 5% = \$138 ;
 interest of \$138 for 4 yr. 3 mo. 6 da. + 3 yr. 3 mo. 6 da. + 2 yr.
 3 mo. 6 da. + 1 yr. 3 mo. 6 da. + 3 mo. 6 da., or 11 yr. 4 mo.
 = \$78.20 ;
 $\$2760 + \$726.80 + \$78.20 = \3565 , the amount due.

74 A KEY TO THE STANDARD ARITHMETIC.

8. Interest of \$3500 for 4 yr. 7 mo. 24 da. @ 9% = \$1464.75 ;
 interest of \$3500 for 1 yr. @ 9% = \$315 ;
 interest of \$315 for 3 yr. 7 mo. 24 da. + 2 yr. 7 mo. 24 da. + 1 yr.
 7 mo. 24 da. + 7 mo. 24 da., or 8 yr. 7 mo. 6 da. = \$243.81 ;
 \$3500 + \$1464.75 + \$243.81 = \$5208.56, the amount due.
9. Interest of \$4100 for 3 yr. 5 mo. 15 da. @ 6% = \$850.75 ;
 interest of \$4100 for 1 yr. @ 6% = \$246 ;
 interest of \$246 for 2 yr. 5 mo. 15 da. + 1 yr. 5 mo. 15 da.
 + 5 mo. 15 da., or 4 yr. 4 mo. 15 da. = \$64.575 ;
 \$4100 + \$850.75 + \$64.575 = \$5015.325, the amount due.
10. Interest on \$5450 for the time @ 6% = \$1547.80 ;
 interest on \$5450 for 1 yr. @ 6% = \$327.00 ;
 interest on \$327 for 8 yr. 11 mo. 6 da. = \$175.27 ;
 \$5450 + \$1547.80 + \$175.27 = \$7173.07, the amount due.
11. Interest on \$10,000 for the time @ 5% = \$2770.83 ;
 interest on \$10,000 for 1 yr. = \$500 ;
 interest on \$500 for 12 yr. 8 mo. 15 da. = \$317.71 ;
 \$10,000 + \$2770.83 + \$317.71 = \$13,088.54.
12. Interest on \$7090 for the time @ 6% = \$2672.93 ;
 interest for 1 yr. = \$425.40 ;
 interest on \$425.40 for 16 yr. 8 mo. 12 da. = \$426.25 ;
 \$7090 + \$2672.93 + \$426.25 = \$10,189.18.

COMPOUND INTEREST.

Page 270.

- | | |
|---------------------------------------|--|
| 2. \$275.00, principal for 1st year; | 3. \$310.00 , principal for 1st year ; |
| <u>16.50</u> , interest for 1st year. | <u>21.70</u> , interest for 1st year. |
| \$291.50, principal for 2d year ; | \$331.70 , principal for 2d year ; |
| <u>17.49</u> , interest for 2d year. | <u>23.219</u> , interest for 2d year. |
| \$308.99, principal for 3d year ; | \$354.919, principal for 3d year ; |
| <u>3.09</u> , interest for 2 mo. | <u>24.844</u> , interest for 3d year. |
| \$312.08, amount for 2 yr. 2 mo. ; | \$379.763, principal for 4th year ; |
| <u>275.00</u> , given principal. | <u>13.292</u> , interest for 6 mo. |
| <u>\$37.08</u> , compound interest. | \$393.055, amount for 3 yr. 6 mo. ; |
| | <u>310.00</u> , given principal. |
| | \$ 83.055, compound interest. |

4. \$425.00, principal for 1st year;
21.25, interest for 1st year.

\$446.25, principal for 2d year;
22.31, interest for 2d year.

\$468.56, principal for 3d year;
9.76, interest for 5 mo.

\$478.32, amount for 2 yr. 5 mo.;
425.00, given principal.

\$53.32, compound interest.

Page 271.

5. \$650.00, principal for 1st year; 6. \$535.00, principal for 1st year;
39.00, interest for 1st year. 37.45, interest for 1st year.

\$689.00, principal for 2d year; \$572.45, principal for 2d year;
41.34, interest for 2d year. 40.07, interest for 2d year.

\$730.34, principal for 3d year; \$612.52, principal for 3d year;
32.865, interest for 9 mo. 42.876, interest for 3d year.

\$763.205, amount for 2 yr. 9 mo.; \$655.396, principal for 4th year;
650.00, given principal. 19.115, interest for 5 mo.

\$113.205, compound interest. \$674.51, amount for 3 yr. 5 mo.,
535.00, given principal.

\$139.51, compound interest.

7. \$580.00, principal for 1st year;
34.80, interest for 1st year.

\$614.80, principal for 2d year;
36.888, interest for 2d year.

\$651.688, principal for 3d year;
39.101, interest for 3d year.

\$690.789, principal for 4th year;
29.934, interest for 8 mo. 20 da.

\$720.72, amount for 3 yr. 8 mo. 20 da.;
580.00, given principal.

\$140.72, compound interest.

8. \$ 260.00 , first principal ;
7.80 , interest for 6 mo.
 \$ 267.80 , second principal ;
8.034 , interest for 6 mo.
 \$ 275.834 , third principal ;
8.275 , interest for 6 mo.
 \$ 284.11 , fourth principal ;
8.52 , interest for 6 mo.
 \$ 292.63 , fifth principal ;
8.78 , interest for 6 mo.
 \$ 301.41 , amount for 2 yr. 6 mo. ;
260.00 , given principal.
 \$ 41.41 , compound interest.
9. \$ 450.00, principal for 1st quarter ;
9.00, interest for 1st quarter.
 \$ 459.00, principal for 2d quarter ;
9.18, interest for 2d quarter.
 \$ 468.18, principal for 3d quarter ;
9.36, interest for 3d quarter.
 \$ 477.54, principal for 4th quarter ;
9.55, interest for 4th quarter.
 \$ 487.09, principal for 1st quarter of 2d year ;
9.74, interest for 1st quarter of 2d year.
 \$ 496.83, principal for 2d quarter of 2d year ;
9.94, interest for 2d quarter of 2d year.
 \$ 506.77, principal for 3d quarter of 2d year ;
10.14, interest for 3d quarter of 2d year.
 \$ 516.91, principal for 4th quarter of 2d year ;
10.34, interest for 4th quarter of 2d year.
 \$ 527.25, principal at beginning of 3d year ;
7.03, interest for 2 mo.
 \$ 534.28, amount for 2 yr. 2 mo. ;
450.00, given principal.
 \$ 84.28, compound interest.

11. \$1.262477, amount of \$1 for 4 yr. @ 6%;
.037874, interest for 6 mo.
 \$1.300351, amount of \$1 for 4 yr. 6 mo. @ 6%;
420.80
 \$547.19, amount of principal for 4 yr. 6 mo. @ 6%;
420.80, given principal.
 \$126.39, compound interest.
12. \$1.157625, amount of \$1 for 3 yr. @ 5%;
.019293, interest for 4 mo.
 \$1.176918, amount of \$1 for 3 yr. 4 mo. @ 5%;
430.75
 \$506.96, amount of principal for 3 yr. 4 mo. @ 5%;
430.75, given principal.
 \$76.21, compound interest.
13. \$1.402552, amount of \$1 for 5 yr. @ 7%;
.049089, interest for 6 mo.
 \$1.451641, amount of \$1 for 5 yr. 6 mo. ;
510.60
 \$741.21, amount of principal for 5 yr. 6 mo. @ 7%;
510.60, given principal.
 \$230.61, compound interest.
14. \$1.418519, amount of \$1 for 6 yr. @ 6%;
.049648, interest for 7 mo.
 \$1.468167, amount of \$1 for 6 yr. 7 mo. ;
750.80
 \$1102.30, amount of principal for 6 yr. 7 mo. @ 6%;
750.80, given principal.
 \$351.50, compound interest.
15. \$1.123600 , amount of \$1 for 2 yr. @ 6%;
.0202248, interest for 3 mo. 18 da.
 \$1.1438248, amount of \$1 for 2 yr. 3 mo. 18 da. ;
672.28
 \$768.97, amount of principal for 2 yr. 3 mo. 18 da. ;
672.28, given principal.
 \$96.69, compound interest.

16. \$1.360489, amount of \$1 for 4 yr. @ 8% ;
.075583, interest for 8 mo. 10 da.
 \$1.436072, amount of \$1 for 4 yr. 8 mo. 10 da. @ 8% ;
856.57
 \$1230.095, amount of principal for given time ;
856.57, given principal.
 \$ 373.525, compound interest.
17. \$1.500730, amount of \$1 for 6 yr. @ 7% ;
.084916, interest for 9 mo. 21 da.
 \$1.585646, amount of \$1 for 6 yr. 9 mo. 21 da. ;
889.37
 \$1410.225, amount of principal for given time ;
889.37 , given principal.
 \$ 520.855, compound interest.
18. \$1.593848, amount of \$1 for 8 yr. @ 6% ;
.060831, interest for 7 mo. 19 da.
 \$1.654679, amount of \$1 for 8 yr. 7 mo. 19 da. ;
985.50
 \$1630.69, amount of principal for 8 yr. 7 mo. 19 da. ;
985.50, given principal.
 \$ 645.19, compound interest.
19. \$1.551328, amount of \$1 for 9 yr. @ 5% ;
.021546, interest for 3 mo. 10 da.
 \$1.572874, amount of \$1 for 9 yr. 3 mo. 10 da. ;
357.50, given principal.
 \$ 562.30, amount of principal for given time ;
357.50, given principal.
 \$ 204.80, compound interest.
20. \$1.191016, amount of \$1 for 3 yr. @ 6% ;
.012902, interest for 2 mo. 5 da.
 \$1.203918, amount of \$1 for 3 yr. 2 mo. 5 da. ;
613.25
 \$ 738.30, amount of principal for given time ;
613.25, given principal.
 \$ 125.05, compound interest.

COMPOUND INTEREST.

79

21. \$ 1.276282, amount of \$ 1 for 5 yr. @ 5% ;
.008722, interest for 21 da.
 \$ 1.280004, amount of \$ 1 for 5 yr. 21 da. ;
5240.75
 \$ 6708.18, amount of principal for given time ;
5240.75, given principal.
 \$ 1467.43, compound interest.
22. \$ 1.360489, amount of \$ 1 for 4 yr. @ 8% ;
.018139, interest for 2 mo.
 \$ 1.378628, amount of \$ 1 for 4 yr. 2 mo. ;
3745
 \$ 5162.96, amount of principal for given time ;
3745.00, given principal.
 \$ 1417.96, compound interest.
23. \$ 1.477455, amount of \$ 1 for 8 yr. @ 5% ;
.019494, interest for 3 mo. 5 da.
 \$ 1.496949, amount of \$ 1 for 8 yr. 3 mo. 5 da. ;
43.75
 \$ 65.49, amount of principal for 8 yr. 3 mo. 5 da. ;
43.75, given principal.
 \$ 21.74, compound interest.
24. \$ 1.418519, amount of \$ 1 for 6 yr. @ 6% ;
.068088, interest for 9 mo. 18 da.
 \$ 1.486607, amount of \$ 1 for 6 yr. 9 mo. 18 da. ;
745.27
 \$ 1107.92, amount of principal for 6 yr. 9 mo. 18 da.
745.27, given principal.
 \$ 362.65, compound interest.

25. \$1.718186, amount of \$1 for 8 yr. @ 7%;
.021715, interest for 2 mo. 5 da.
 \$1.739901, amount of \$1 for 8 yr. 2 mo. 5 da. ;
319.50
 \$555.90, amount of principal for given time ;
 319.50, given principal.
\$236.40, compound interest.
26. \$1.050000, amount of \$1 for 1 yr. @ 5%;
.028437, interest for 6 mo. 15 da.
 \$1.078437, amount of \$1 for 1 yr. 6 mo. 15 da. ;
3246.98
 \$3501.66, amount of principal for given time ;
 3246.98, given principal.
\$254.68, compound interest.
27. \$1.310796, amount of \$1 for 4 yr. @ 7%;
.0749338, interest for 9 mo. 24 da.
 \$1.3857298, amount of \$1 for 4 yr. 9 mo. 24 da. ;
4921.50
 \$6819.869, amount of principal for given time ;
 4921.50 , given principal.
\$1898.369, compound interest.

PROMISSORY NOTES.

Page 275.

8. Time, 1 yr. 9 mo. 12 da.
 The interest of \$1 for 1 yr. = \$.06
 The interest of \$1 for 9 mo. = .045
 The interest of \$1 for 12 da. = .002
 The interest of \$1 for 1 yr. 9 mo. 12 da. = \$.107
 The interest of \$175 = \$.107 \times 175, or \$18.725.

9. Time, 1 yr. 5 mo. 6 da.

$$\$380 \times .05 = \$19, \text{ interest for 1 yr. ;}$$

$$\$19 \div 12 = \$1.58\frac{1}{3}, \text{ interest for 1 mo. ;}$$

$$\$1.58\frac{1}{3} \times 17.2 = \$27.23, \text{ interest for 1 yr. 5 mo. 6 da.}$$

10. Time, 1 yr. 28 da.

$$\$575$$

$$.07$$

$$\$40.25, \text{ interest for 1 yr. ;}$$

$$\frac{1}{4} \text{ of interest for 1 yr.} = 1.677, \text{ interest for 15 da. ;}$$

$$\frac{1}{3} \text{ of interest for 15 da.} = 1.118, \text{ interest for 10 da. ;}$$

$$\frac{1}{3} \text{ of interest for 15 da.} = .335, \text{ interest for 3 da.}$$

$$\$43.38, \text{ interest for 1 yr. 28 da.}$$

11. Time, 1 yr. 2 mo. 16 da.

$$\$860$$

$$.05$$

$$\$43.00, \text{ interest for 1 yr. ;}$$

$$\frac{1}{4} \text{ of interest for 1 yr.} = 7.17, \text{ interest for 2 mo. ;}$$

$$\frac{1}{4} \text{ of interest for 2 mo.} = 1.79, \text{ interest for 15 da. ;}$$

$$\frac{1}{15} \text{ of interest for 15 da.} = .12, \text{ interest for 1 da.}$$

$$\$52.08, \text{ interest for 1 yr. 2 mo. 16 da.}$$

PARTIAL PAYMENTS.

Page 276.

1. Principal	\$780.00
Interest to Dec. 22, 1890	43.32
Amount of principal, Dec. 22, 1890	<u>\$803.32</u>
First payment	\$175.00
Interest on payment to Dec. 22, 1890	8.137
Second payment	360.00
Interest on payment to Dec. 22, 1890	8.64
Amount of payments, Dec. 22, 1890	<u>551.78</u>
Amount due Dec. 22, 1890	<u>\$251.54</u>

82 A KEY TO THE STANDARD ARITHMETIC.

2. Principal	\$ 1245.00
Interest to Oct. 30, 1890	59.76
	<hr/>
Amount of principal, Oct. 30, 1890	\$ 1304.76
First payment	\$ 236.00
Interest on payment to Oct. 30, 1890	6.49
Second payment	350.00
Interest on payment to Oct. 30, 1890	7.58
Third payment	180.00
Interest on payment to Oct. 30, 1890	2.40
Fourth payment	220.00
Interest on payment to Oct. 30, 1890	2.09
	<hr/>
Amount of payments to Oct. 30, 1890	1004.56
	<hr/>
Amount due Oct. 30, 1890	\$ 300.20
3. Principal	\$ 3500.00
Interest to Aug. 3, 1886	236.83
	<hr/>
Amount of principal, Aug. 3, 1886	\$ 3736.83
First payment	\$ 320.00
Interest to Aug. 3, 1886	18.23
Second payment	476.00
Interest to Aug. 3, 1886	16.47
Third payment	525.00
Interest to Aug. 3, 1886	10.51
Fourth payment	700.00
Interest to Aug. 3, 1886	5.31
	<hr/>
Amount of payments to Aug. 3, 1886	2071.52
	<hr/>
Amount due Aug. 3, 1886	\$ 1665.31

1888 47
87 624
PARTIAL PAYMENTS.

045
046

4. Principal	\$ 1500.00
Interest to April 1, 1892	120.00
Amount of principal, April 1, 1892	<u>\$ 1620.00</u>
First payment	\$ 270.00
Interest to April 1, 1892	17.46
Second payment	328.00
Interest to April 1, 1892	15.89
Third payment	145.00
Interest to April 1, 1892	6.476
Fourth payment	195.00
Interest to April 1, 1892	6.50
Fifth payment	200.00
Interest to April 1, 1892	2.13
Amount of payments to April 1, 1892	<u>1186.46</u>
Amount due April 1, 1892	<u>\$ 433.54</u>

Page 278.

2. Principal	\$ 850.00
Interest to April 1, 1888	39.24
Amount	<u>\$ 889.24</u>
First payment	250.00
New principal	<u>\$ 639.24</u>
Interest to Nov. 18, 1888	24.18
Amount	<u>\$ 663.42</u>
Second payment	300.00
New principal	<u>\$ 363.42</u>
Interest to Jan. 1, 1889	2.60
Amount due Jan. 1, 1889	<u>\$ 366.02</u>

84 A KEY TO THE STANDARD ARITHMETIC.

3. Principal	\$1000.00
Interest to June 1, 1881	11.47
<u>Amount</u>	<u>\$1011.47</u>
First payment	200.00
<u>New principal</u>	<u>\$811.47</u>
Interest to Sept. 10, 1881	15.62
<u>Amount</u>	<u>\$827.09</u>
Second payment	350.00
<u>New principal</u>	<u>\$477.09</u>
Interest to April 2, 1882	18.74
<u>Amount due April 2, 1882</u>	<u>\$495.83</u>
4. Principal	\$1115.00
Interest to Sept. 15, 1883	12.82
<u>Amount</u>	<u>\$1127.82</u>
First payment	180.00
<u>New principal</u>	<u>\$947.82</u>
Interest to Jan. 2, 1884	16.90
<u>Amount</u>	<u>\$964.72</u>
Second payment	225.00
<u>New principal</u>	<u>\$739.72</u>
Interest to March 20, 1884	9.62
<u>Amount</u>	<u>\$749.34</u>
Third payment	300.00
<u>New principal</u>	<u>\$449.34</u>
Interest to May 1, 1884	3.07
<u>Amount due May 1, 1884</u>	<u>\$452.41</u>

PARTIAL PAYMENTS.

85

5. Principal	\$ 750.00
Interest to March 1, 1885	7.50
Amount	<u>\$ 757.50</u>
First payment	125.00
New principal	<u>\$ 632.50</u>
Interest to July 6, 1885	18.18
Amount	<u>\$ 645.68</u>
Second payment	325.00
New principal	<u>\$ 320.68</u>
Interest to Dec. 10, 1885	8.23
Amount	<u>\$ 328.91</u>
Third payment	75.00
New principal	<u>\$ 253.91</u>
Interest to June 1, 1886	7.24
Amount due June 1, 1886	<u>\$ 261.15</u>
6. Principal	\$ 900.00
Interest to Sept. 8, 1886	27.30
Amount	<u>\$ 927.30</u>
First payment	115.00
New principal	<u>\$ 812.30</u>
Interest to June 20, 1887	44.54
Amount	<u>\$ 856.84</u>
Second payment	175.00
New principal	<u>\$ 681.84</u>
Interest to Dec. 14, 1887	23.07
Amount	<u>\$ 704.91</u>
Third payment	200.00
New principal	<u>\$ 504.91</u>
Interest to May 26, 1888	15.90
Amount due May 26, 1888	<u>\$ 520.81</u>

7. Principal	\$ 1200.00
Interest to Aug. 1, 1887	49.00
Amount	<u>\$ 1249.00</u>
First payment	175.00
New principal	<u>\$ 1074.00</u>
Interest to Dec. 1, 1887	25.06
Amount	<u>\$ 1099.06</u>
Second payment	225.00
New principal	<u>\$ 874.06</u>
Interest to July 1, 1888	35.69
Amount	<u>\$ 909.75</u>
Third payment	250.00
New principal	<u>\$ 659.75</u>
Interest to Nov. 1, 1888	15.39
Amount	<u>\$ 675.14</u>
Fourth payment	100.00
New principal	<u>\$ 575.14</u>
Interest to Jan. 1, 1889,	6.71
Amount due Jan. 1, 1889	<u>\$ 581.85</u>
8. Principal	\$ 1450.00
Interest to June 8, 1887 (the first payment being less than the interest due)	83.13
Amount	<u>\$ 1533.13</u>
Sum of first and second payments	200.00
New principal	<u>\$ 1333.13</u>
Interest to Oct. 20, 1887	39.11
Amount	<u>\$ 1372.24</u>
Third payment	210.00
New principal	<u>\$ 1162.24</u>
Interest to June 24, 1888 (the fourth payment being less than the interest due)	63.02
Amount	<u>\$ 1225.26</u>
Fourth payment	15.00
Amount due June 24, 1888	<u>\$ 1210.26</u>

PROBLEMS IN INTEREST.

87

9. Principal	\$ 1800.00
Interest to Jan. 4, 1888	60.80
Amount	\$ 1860.80
First payment	200.00
New principal	\$ 1660.80
Interest to June 5, 1889 (the second payment being less than the interest due)	188.59
Amount	\$ 1849.39
Sum of second and third payments	600.00
New principal	\$ 1249.39
Interest to Jan. 3, 1890	57.75
Amount due Jan. 3, 1890	\$ 1807.14

PROBLEMS IN INTEREST.

Page 279.

- Interest of \$ 325 for 1 yr. 6 mo. at 1 % = \$ 4.875 ;
 $\$ 19.50 \div \$ 4.875 = 4$. Therefore the rate is 4 %.
- Interest of \$ 480 for 2 yr. 3 mo. at 1 % = \$ 10.80 ;
 $\$ 64.80 \div \$ 10.80 = 6$. Therefore the rate is 6 %.
- Interest of \$ 240 for 1 yr. 9 mo. at 1 % = \$ 4.20 ;
 $\$ 29.40 \div \$ 4.20 = 7$. Therefore the rate is 7 %.
- Interest of \$ 375 for 1 yr. 5 mo. at 1 % = \$ 5.31 $\frac{1}{2}$;
 $\$ 31.87\frac{1}{2} \div \$ 5.31\frac{1}{2} = 6$. Therefore the rate is 6 %.
- Interest of \$ 500 for 2 yr. 2 mo. at 1 % = \$ 10.83 $\frac{1}{3}$;
 $\$ 26.25 \div \$ 10.83\frac{1}{3} = 2\frac{1}{3}$. Therefore the rate is 2 $\frac{1}{3}$ %.
- Interest of \$ 475 for 3 yr. 4 mo. at 1 % = \$ 15.83 $\frac{1}{3}$;
 $\$ 95 \div \$ 15.83\frac{1}{3} = 6$. Therefore the rate is 6 %.
- \$ 490 - \$ 100 = \$ 390, the net income ;
 $\$ 390 \div \$ 6000 = .06\frac{1}{2}$. Therefore the rate was 6 $\frac{1}{2}$ %.

9. $\$1680.125 - \$1575 = \$55.125$, interest ;
 Interest on $\$1575$ at 1% for 7 mo. = $\$9.18\frac{1}{2}$;
 $\$55.125 \div \$9.18\frac{1}{2} = 6$. Therefore the rate is 6% .
10. $\$785 - \$260 = \$525$, the sum the farmer realized ;
 $\$525 \div \$10,500 = .05$, the amount realized on a dollar ; or, he realized 5% on his investment.

Page 280.

2. Since $\$300$ at 5% produces $\$15$ annually, it will require as many years to produce $\$37.50$ as $\$15$ is contained times in $\$37.50$, which is $2\frac{1}{2}$ times ; therefore the time is 2 yr. 6 mo.

3. $\$480$ at 3% will produce $\$14.40$ annually ;

$$\$74.28 \div \$14.40 = 5\frac{1}{10}$$

Therefore it will require $5\frac{1}{10}$ yr., or 5 yr. 1 mo. 27 da.

4. $\$400$ at 7% will produce $\$28$ annually ;

$$\$62.06\frac{2}{3} \div \$28 = 2\frac{2}{10}$$

Therefore it will require $2\frac{2}{10}$ yr., or 2 yr. 2 mo. 18 da.

5. $\$940$ at 6% will produce $\$56.40$ annually ;

$$\$432.40 \div \$56.40 = 7\frac{2}{3}$$

Therefore it will require $7\frac{2}{3}$ yr., or 7 yr. 8 mo.

6. $\$860$ at 5% will produce $\$43$ annually ;

$$\$247.25 \div \$43 = 5\frac{1}{2}$$

Therefore it will require $5\frac{1}{2}$ yr., or 5 yr. 9 mo.

7. $\$984$ at 8% will produce $\$78.72$ annually ;

$$\$288.64 \div \$78.72 = 3\frac{2}{3}$$

Therefore it will require $3\frac{2}{3}$ yr., or 3 yr. 8 mo.

8. $\$998$ at 5% will produce $\$49.90$ annually ;

$$\$185.145 \div \$49.90 = 3.71$$

Therefore it will require 3.71 yr., or 3 yr. 8 mo. 16 da.

9. \$1200 at 7% will produce \$84 annually;

$\$1200 \div \$84 = 14\frac{2}{3}$. Therefore it will require $14\frac{2}{3}$ yr.

Or, since the interest is 7% of the principal, it will require as many years to produce a sum equal to the principal as 7% is contained times in 100%, or $14\frac{2}{3}$ yr.

10. For any sum to double itself by adding 8% annually will require as many years as 8% is contained times in 100%, or $12\frac{1}{2}$ yr.

11. $\$641.80 - \$530 = \$111.80$, the interest;

\$530 at 6% will produce \$31.80 annually;

$\$111.80 \div \$31.80 = 3\frac{1}{2}$.

Therefore it will require $3\frac{1}{2}$ yr., or 3 yr. 6 mo.

12. \$1200 at $5\frac{1}{2}$ % will produce \$66 in 1 yr.;

$\$1200 \div \$66 = 18\frac{2}{3}$. Therefore it will require $18\frac{2}{3}$ yr.

13. $\$495.25 - \$475 = \$14.25$, the interest;

\$475 at 6% will produce \$28.50 in a year;

$\$14.25 \div \$28.50 = \frac{1}{2}$.

Therefore it will require $\frac{1}{2}$ yr., or 6 mo., to produce \$14.25.

6 mo. after April 1, 1891, is Oct. 1, 1891.

14. The interest on a sum of money at 8% will equal the principal in as many years as 8% is contained times in 100%, or $12\frac{1}{2}$ yr.; therefore it will be equal to double the principal in 25 yr.; June 24, 1850 + 25 yr. = June 24, 1875.

Page 281.

2. The interest of \$1 for 2 yr. at 5% = \$.10;

$\$25.50 \div \$.10 = 255$. Therefore the sum is \$255.

3. The interest of \$1 for 2 yr. 3 mo. at 6% = \$.135;

$\$33.75 \div \$.135 = 250$. Therefore the sum is \$250.

4. The interest of \$1 for 3 yr. 4 mo. at 6% = \$.20;

$\$43.86 \div \$.20 = 219.30$. Therefore the sum is \$219.30.

5. The interest of \$1 for 6 mo. 18 da. at 7% = \$.0385;

$\$49.75 \div \$.0385 = 1292.21$. Therefore the principal is \$1292.21.

6. The interest of \$1 for 5 mo. 27 da. at 8% = \$.039 $\frac{1}{3}$;
 $\$50.32 + \$.039\frac{1}{3} = 1279.32$. Therefore the principal is \$1279.32.
7. The interest of \$1 for 9 mo. 15 da. at 9% = \$.07125;
 $\$38.40 + \$.07125 = 538.95$. Therefore the principal is \$538.95.
8. The interest of \$1 for 2 mo. 21 da. at 6% = \$.0135;
 $\$45.80 + \$.0135 = 3392.59$.
 Therefore the principal is \$3392.59.
9. The interest of \$1 for 7 mo. 25 da. at 5% = \$.032639;
 $\$68.50 + \$.032639 = 2098.72$.
 Therefore the principal is \$2098.72.
10. The interest of \$1 for 4 yr. 7 mo. at 7% = \$.32083;
 $\$95.35 + \$.32083 = 297.19$. Therefore the principal is \$297.19.
11. The amount of \$1 at 6% for 2 yr. 2 mo. 16 da. = \$1.132 $\frac{2}{3}$;
 $\$2575 \div \$1.132\frac{2}{3} = 2273.39$.
 Therefore the principal is \$2273.39.
12. The interest of \$1 at 6% for 2 mo. 3 da. = \$.0105;
 $\$17.78 + \$.0105 = 1693.33$. Therefore the principal is \$1693.33.
13. 6 $\frac{1}{2}$ % of investment = \$895;
 1% of investment = \$895 \div 6 $\frac{1}{2}$, or \$137.6923;
 the entire investment = 100 times \$137.6923, or \$13769.23.

TRUE DISCOUNT.

Page 283.

2. The amount of \$1 for 9 mo. at 6% is \$1.045;
 $\$576.75 \div 1.045 = \551.91 , present worth;
 $\$576.75 - \$551.91 = \$24.84$, true discount.
3. \$1.04 $\frac{1}{2}$ = amount of \$1 for 10 mo. at 5%;
 $\$760.85 \div 1.04\frac{1}{2} = \730.42 , present worth;
 $\$760.85 - \$730.42 = \$30.43$, true discount.

4. $\$1.105 =$ amount of $\$1$ for $1\frac{1}{2}$ yr. at 7% ;
 $\$437.50 \div 1.105 = \395.93 , present worth;
 $\$437.50 - \$395.93 = \$41.57$, true discount.
5. $\$1.11 =$ amount of $\$1$ for 2 years at $5\frac{1}{2}\%$.
 $\$648.60 \div 1.11 = \584.32 , present worth;
 $\$648.60 - \$584.32 = \$64.28$, true discount.
6. $\$1.083 =$ amount of $\$1$ for 1 yr. 4 mo. 18 da. at 6% ;
 $\$1200 \div 1.083 = \1108.03 , present worth;
 $\$1200 - \$1108.03 = \$91.97$, true discount.
 $\$1.069\frac{1}{8} =$ amount of $\$1$ for 1 yr. 4 mo. 18 da. at 5% ;
 $\$1200 \div 1.069\frac{1}{8} = \1122.37 , present worth;
 $\$1200 - \$1122.37 = \$77.63$, true discount.
7. $\$1.104\frac{1}{3} =$ amount of $\$1$ for 1 yr. 3 mo. 20 da. at 8% ;
 $\$1608 \div 1.104\frac{1}{3} = \1455.93 , present worth;
 $\$1608 - \$1455.93 = \$152.07$, true discount.
 $\$1.078\frac{1}{3} =$ amount of $\$1$ for 1 yr. 3 mo. 20 da. at 6% ;
 $\$1608 \div 1.078\frac{1}{3} = \1491.19 , present worth;
 $\$1608 - \$1491.19 = \$116.81$, true discount.
8. $\$1.0347\frac{1}{2} =$ amount of $\$1$ for 5 mo. 17 da. @ $7\frac{1}{2}\%$;
 $\$2575 \div 1.0347\frac{1}{2} = \2488.42 , present worth;
 $\$2575 - \$2488.42 = \$86.58$, true discount.
 $\$1.0301\frac{1}{8} =$ amount of $\$1$ for 5 mo. 17 da. @ $6\frac{1}{8}\%$;
 $\$2575 \div 1.0301\frac{1}{8} = \2499.63 , present worth;
 $\$2575 - \$2499.63 = \$75.37$, true discount.
9. $\$1.02 =$ amount of $\$1$ @ 8% for 90 da. ;
 $\$1357.85 \div 1.02 = \1331.23 , present worth;
 $\$1357.85 - \$1331.23 = \$26.62$, true discount.
 $\$1.01\frac{7}{8} =$ amount of $\$1$ @ $7\frac{1}{8}\%$ for 90 da. ;
 $\$1357.85 \div 1.01\frac{7}{8} = \1332.86 , present worth;
 $\$1357.85 - \$1332.86 = \$24.99$, true discount.

92 A KEY TO THE STANDARD ARITHMETIC.

10. $\$1.1269\frac{7}{12}$ = the amount of $\$1$ @ $5\frac{1}{2}\%$ for 2 yr. 3 mo. 21 da. ;
 $\$3180.50 + 1.1269\frac{7}{12} = \2822.20 , present worth ;
 $\$3180.50 - \$2822.20 = \$358.30$, true discount.
11. $\$1.18\frac{1}{2}$ = amount of $\$1$ @ 5% for 3 yr. 8 mo. ;
 $\$175.90 + 1.18\frac{1}{2} = \148.65 , present worth.
12. $\$3468 - 2\%$ of $\$3468 = \3398.64 , the sum to be paid in cash ;
 $\$1.0175$ = amount of $\$1$ @ 7% for 3 mo. ;
 $\$3468 + 1.0175 = \3408.35 , present worth ;
 $\$3408.35 - \$3398.64 = \$9.71$, better.
13. $\$1.0460\frac{5}{12}$ = amount of $\$1$ @ $6\frac{1}{2}\%$ for 8 mo. 15 da. :
 $\$460.75 + 1.0460\frac{5}{12} = \440.47 , present worth.
14. $\$1.1375$ = amount of $\$1$ @ 6% for 2 yr. 3 mo. 15 da. ;
 $\$248.76 + 1.1375 = \218.69 , present worth ;
 $\$248.76 - \$218.69 = \$30.07$, true discount.
 $\$.1375$ = interest on $\$1$ @ 6% for 2 yr. 3 mo. 15 da. ;
 $\$.1375 \times 248.76 = \34.20 , interest on $\$248.76$;
 $\$34.20 - \$30.07 = \$4.13$, the difference.

NOTE. The difference between the true discount and the interest is equal to the interest upon the true discount for the given time.

BANK DISCOUNT.

Page 286.

3. Feb. 4th + 3 mo. = May 4th, date of maturity ;
 from March 10th to May 4th = 55 da., term of discount ;
 the interest of $\$764.75$ @ 6% for 55 da. = $\$7.01$, bank discount ;
 $\$764.75 - \$7.01 = \$757.74$, proceeds.
4. May 14th + 3 mo. = Aug. 14th, date of maturity ;
 from May 25th to Aug. 14th = 81 da., term of discount ;
 the interest of $\$537.45$ @ 6% for 81 da. = $\$7.26$, discount ;
 $\$537.45 - \$7.26 = \$530.19$, proceeds.

5. Oct. 6th + 60 da. = Dec. 5th, date of maturity ;
 from Nov. 1st to Dec. 5th = 34 da., term of discount ;
 the interest of \$ 850.50 @ 6% for 34 da. = \$ 4.82, discount ;
 \$ 850.50 - \$ 4.82 = \$ 845.68, proceeds.
6. Jan. 8th + 4 mo. = May 8th, date of maturity ;
 from April 12th to May 8th = 26 da., term of discount ;
 the interest of \$ 235.68 for 26 da. at 6% = \$ 1.02, discount ;
 \$ 235.68 - \$ 1.02 = \$ 234.66, proceeds.
7. April 2d + 5 mo. = Sept. 2d, date of maturity ;
 from May 29th to Sept. 2d = 96 da., term of discount ;
 the interest of \$ 472.48 at 7% for 96 da. = \$ 8.82, discount ;
 \$ 472.48 - \$ 8.82 = \$ 463.66, proceeds.

Page 287.

8. June 24th + 4 mo. 3 da. = Oct. 27th, date of maturity ;
 from Sept. 10th to Oct. 27th = 47 da., term of discount ;
 the interest of \$ 1000 for 47 da. at 5% = \$ 6.53, discount ;
 \$ 1000 - \$ 6.53 = \$ 993.47, proceeds.
9. July 5th + 3 mo. 3 da. = Oct. 8th, date of maturity ;
 from Aug. 5th to Oct. 8th = 64 da., term of discount ;
 the amount of \$ 1100 at 6% for 3 mo. 3 da. = \$ 1117.05 ;
 the interest of \$ 1117.05 for 64 da. at 6% = \$ 11.92, discount ;
 \$ 1117.05 - \$ 11.92 = \$ 1105.13, proceeds.
10. May 3d + 63 da. = July 5th, date of maturity ;
 from May 20th to July 5th = 46 da., term of discount ;
 the amount of \$ 135.50 for 63 da. at 6% = \$ 136.92 ;
 the interest of \$ 136.92 for 46 da. at 6% = \$ 1.05, discount ;
 \$ 136.92 - \$ 1.05 = \$ 135.87, proceeds.
11. Feb. 16th + 4 mo. 3 da. = June 19th, date of maturity ;
 from April 4th to June 19th = 76 da., term of discount ;
 the amount of \$ 637.85 for 4 mo. 3 da. at 7% = \$ 653.11 ;
 the interest of \$ 653.11, at 7%, for 76 da. = \$ 9.65, discount ;
 \$ 653.11 - \$ 9.65 = \$ 643.46, proceeds.

94 A KEY TO THE STANDARD ARITHMETIC.

12. Aug. 3d + 93 da. = Nov. 4th, date of maturity ;
 from Sept. 2d to Nov. 4th = 63 da., term of discount ;
 the interest of \$ 1200 for 63 da. at 8 % = \$ 16.80, discount ;
 \$ 1200 - \$ 16.80 = \$ 1183.20, proceeds.

Page 288.

2. \$.0155 = interest of \$ 1 for 3 mo. 3 da. at 6 % ;
 \$ 1 - \$.0155 = \$.9845, proceeds of \$ 1 ;
 \$ 590.70 ÷ \$.9845 = 600. Therefore \$ 600 is the face of the note.
3. \$ 1 - \$.0105 = \$.9895, proceeds of \$ 1 ;
 \$ 336.43 ÷ \$.9895 = 340. Therefore \$ 340 is the face of the note.
4. \$ 1 - \$.0070 $\frac{1}{2}$ = \$.9929 $\frac{1}{2}$, proceeds of \$ 1 ;
 \$ 1869.35 ÷ \$.9929 $\frac{1}{2}$ = 1882.68.
 Therefore \$ 1882.68 is the face of the note.
5. \$ 1 - \$.0105 = \$.9895, proceeds of \$ 1 ;
 \$ 1000 ÷ \$.9895 = 1010.61.
 Therefore \$ 1010.61 is the face of the note.
6. \$ 1 - \$.015 $\frac{1}{2}$ = \$.984 $\frac{1}{2}$, proceeds of \$ 1 ;
 \$ 895 ÷ \$.984 $\frac{1}{2}$ = 909.14.
 Therefore \$ 909.14 is the face of the note.

STOCKS AND BONDS.

Page 292.

2. 89 % + $\frac{1}{8}$ % = 89 $\frac{1}{8}$ % ;
 89 $\frac{1}{8}$ % of \$ 100 = \$ 89.125, cost of one share ;
 \$ 89.125 × 150 = \$ 13368.75, the entire cost.
3. 102 % + $\frac{1}{8}$ % = 102 $\frac{1}{8}$ % ;
 102 $\frac{1}{8}$ % of \$ 100 = \$ 102.125, cost of one share ;
 \$ 102.125 × 76 = \$ 7761.50, the entire cost.
4. \$ 55 + \$ $\frac{1}{8}$ = \$ 55.125, cost of one share ;
 \$ 55.125 × 45 = \$ 2480.625, the entire cost.

Page 293.

5. $\$33\frac{1}{4} + \$\frac{1}{8} = \$33.875$, cost of one share ;
 $\$33.875 \times 120 = \4065.00 , the entire cost.
6. $108\frac{1}{4}\% + \frac{1}{8}\% = 108\frac{3}{8}\%$;
 $108\frac{3}{8}\%$ of $\$1.00 = \1.08375 , the cost of each dollar of bonds ;
 $\$1.08375 \times 6000 = \6502.50 , the entire cost.
7. $\$113\frac{1}{2} + \$\frac{1}{8} = \$113\frac{5}{8}$, cost of one share ;
 $\$113.625 \times 125 = \$14,203.125$, the entire cost.
8. $\$94 + \$\frac{1}{8} = \$94.125$, cost of one share ;
 $\$101\frac{1}{2} - \$\frac{1}{8} = \$101.375$, sum realized on one share ;
 $\$101.375 - \$94.125 = \$7.25$, gain on one share ;
 $\$7.25 \times 180 = \1305.00 , gain.
9. $100\% - 8\frac{3}{4}\% = 91\frac{1}{4}\%$; $91\frac{1}{4}\% + \frac{1}{8}\% = 91\frac{3}{8}\%$;
 $91\frac{3}{8}\%$ of $\$100 = \91.375 , cost of one share ;
 $\$91.375 \times 85 = \7766.875 , the entire cost.
10. $112\frac{3}{4}\% + \frac{1}{8}\% = 112\frac{7}{8}\%$;
 $112\frac{7}{8}\%$ of $\$100 = \112.875 , cost of one share ;
 $\$112.875 \times 375 = \$42,328.125$, the entire cost.
11. $\$116\frac{3}{8} + \$\frac{1}{8} = \$116\frac{1}{2}$, cost of one share ;
 $\$116.50 \times 125 = \$14,562.50$, the entire cost.
12. $\$106\frac{1}{4} + \$\frac{1}{8} = \$106\frac{3}{8}$, cost of one share ;
 $\$109\frac{3}{8} - \$\frac{1}{8} = \$109\frac{2}{8}$, sum realized on one share ;
 $\$109\frac{2}{8} - \$106\frac{3}{8} = \$3.25$, sum gained on one share ;
 $\$3.25 \times 130 = \422.50 , the entire gain.
14. $78\% + \frac{1}{8}\% = 78\frac{1}{8}\%$;
 $78\frac{1}{8}\%$ of $\$100 = \78.125 , cost of one share ;
 $\$9875 \div \$78.125 = 120$, the number of shares.

96 A KEY TO THE STANDARD ARITHMETIC.

15. $61\frac{1}{4}\% + \frac{1}{8}\% = 61\frac{3}{8}\%$;
 $61\frac{3}{8}\%$ of \$100 = \$61.375, cost of one share ;
 $\$6874 \div \$61.375 = 112$, the number of shares.
16. $115\frac{3}{4}\%$ of \$100 = \$115.75 ;
 $\$18,520 \div \$115.75 = 160$, the number of shares.

Page 294.

18. $\$3457.50 \div \$57.625 = 60$, the number of shares ;
5% of the par value of 60 shares, or \$6000 = \$300, annual income.
19. $\$4565 \div \$114.125 = 40$, the number of shares ;
7% of \$4000 = \$280, annual income.
20. $\$10,777.375 \div 98.875 = 109$, the number of shares ;
10% of \$10,900 = \$1090, annual income.
21. $\$6000 \div \$75 = 80$, the number of shares of 6% stock ;
6% of \$8000 = \$480, income from 6% stock ;
 $\$6000 \div \$60 = 100$, the number of shares of 5% stock ;
5% of \$10,000 = \$500, income from 5% stock ;
 $\$500 - \$480 = \$20$, in favor of 5% stock at 60%.
22. $\$15180 \div \$94.875 = 160$, the number of shares ;
 $4\frac{1}{2}\%$ of \$16,000 = \$720, annual income.

Page 295.

24. $\$840 \div \7 (income from one share) = 120, the number of shares ;
 $101\frac{1}{2}\% + \frac{1}{8}\% = 101\frac{5}{8}\%$;
 $101\frac{5}{8}\%$ of \$100 = \$101.625, cost of one share ;
 $\$101.625 \times 120 = \$12,195$, cost of stock.
25. $\$1600 \div \$10 = 160$, the number of shares ;
 $\$142\frac{1}{2} \times 160 = \$22,740$, cost of stock.
26. $\$900 \div \$4 = 225$, the number of shares ;
 $\$121\frac{3}{8} \times 225 = \$27,309.375$, cost of stock.

27. $\$1000 \div \$5 = 200$, the number of shares ;
 $\$95\frac{1}{2} \times 200 = \$19,125$, cost of stock.
29. $\$6 =$ income from one share ;
 $\$75 =$ cost of one share ;
 $\$6 \div \$75 = .08$, or 8% the rate of interest.
30. $\$6 \div \$90 = .06\frac{2}{3}$, or $6\frac{2}{3}\%$ the rate of interest.
32. $\$10$, income on investment, $\div .07 = \$142\frac{2}{7}$, cost of stock.
 Since $\$142\frac{2}{7}$ is paid for a share of stock whose par value is $\$100$,
 $\$142\frac{2}{7}$ is $142\frac{2}{7}\%$ of the par value.
33. $\$12$, the income on the investment, $\div .08 = \$150$;
 $\$150 = 150\%$ of the par value.

REVIEW EXERCISES — ORAL.

Page 296.

1. Since he spent 25% of his money, he had but 75% left ; 75% of $\$360$ is $\$270$.
2. Since he saved $33\frac{1}{3}\%$, or $\frac{1}{3}$, of his salary, he must have spent $\frac{2}{3}$ of it ; $\frac{2}{3}$ of $\$1500$ is $\$1000$.
3. Since he took 10% less than he asked, he took 90%, or $\frac{9}{10}$, of his asking price ; since $\frac{9}{10}$ of his asking price was $\$36$, $\frac{1}{10}$ of it was $\$4$, and the asking price 10 times $\$4$, or $\$40$.
4. Since he saves $\$15$ per month, he saves $\frac{1}{6}$, or $\frac{1}{6}$, of his earnings, or 25% of his earnings.
5. $\$24$ is $\frac{2}{3}$, or $\frac{2}{3}$, or $66\frac{2}{3}\%$, of $\$36$.
6. He makes $\$6$, and since the watch cost him $\$14$, he makes $\frac{3}{7}$, or $\frac{3}{7}$, or $42\frac{2}{7}\%$ of the cost.
7. Since $\$60$ is $62\frac{1}{2}\%$, or $\frac{5}{8}$, of a certain sum, $\frac{1}{8}$ of the sum is $\frac{1}{8}$ of $\$60$, or $\$12$, and the whole sum is 8 times $\$12$, or $\$96$.
8. Since $\$45$ was 15% of the cost of the horse, 1% of the cost of the horse was $\frac{1}{15}$ of $\$45$, or $\$3$, and the cost was 100 times $\$3$, or $\$300$.

9. Since he sold the coal at an advance of 20%, \$4.80 was 120% of the cost, and since \$4.80 was 120% of the cost, 1% of the cost was \$.04, and the cost 100 times \$.04, or \$4.

10. Since he received but 75%, or $\frac{3}{4}$, of the cost, $\frac{3}{4}$ of the cost was \$1.50; $\frac{1}{4}$ of the cost was \$.50, and the cost 4 times \$.50, or \$2.

11. Since I gained 20%, or $\frac{1}{5}$, of the cost, I gained $\frac{1}{5}$ of \$200, or \$40; \$200 + \$40, or \$240, is, therefore, the selling price.

12. The gain is $2\frac{1}{2}\%$ upon an investment of 10¢, or the gain is $\frac{1}{4}$ of the cost, or 25%.

13. Since he buys the goods at 80% of the retail price, and sells them at the retail price, he gains 20% on 80%, or $\frac{1}{5}$, or 25%, of his investment.

14. Since the butter was sold at a gain of 20% of the cost, 6¢ was 20% of $\frac{1}{5}$ of the cost, and the cost was 5 times 6¢, or 30¢.

Page 297.

15. Since on one cow I gained 25%, \$45 must have been 125%, or $\frac{5}{4}$, of the cost; the cost of that one was, therefore, \$36. Since I lost 25% on the other, \$45 must have been 75%, or $\frac{3}{4}$, of the cost; the cost of that one was, therefore, \$60.

Since one cost \$36, and the other \$60, the cost of both was \$96, and since the two cows were sold for \$90, the loss was \$6.

16. If he sold 4 apples for 10¢, he sold 3 for $\frac{3}{4}$ of 10¢, or $7\frac{1}{2}\%$. Since he bought 3 for 5¢, he gained $2\frac{1}{2}\%$ on every 5¢, which is $\frac{1}{2}$, or 50%.

17. Since the boy lost 20% of his money, 80¢ was 20%, or $\frac{1}{5}$, of his money; therefore his money was 5 times 80¢, or \$4.

18. Since \$18 was 30%, or $\frac{3}{10}$, of what B then had, he must have had 10 times $\frac{1}{3}$ of \$18, or \$60 after gaining \$18, and \$60 - \$18, or \$42 at first.

19. If he lost 20% of the flour, he had but 80% of it left; since he then sold 25%, or $\frac{1}{4}$, of the remainder, he must have had $\frac{3}{4}$ of the remainder left; $\frac{3}{4}$ of 80% is 60%, the per cent of the whole left.

20. Since one pipe increases the quantity of water 5% of 60 bbl., or 3 bbl., per hour, and since the other decreases the quantity 15% of 60 bbl., or 9 bbl., per hour, 6 bbl. more run out per hour than run in, and the quantity of water remaining in the cistern at the end of an hour will be 60 - 6, or 54 bbl.

21. Since he received a discount of 40% from the price at which he sells the goods, every dollar's worth of goods sold cost him only 60¢. He gains, therefore, 40¢ on every 60¢ invested, or $\frac{2}{3}$, or $66\frac{2}{3}\%$, of his investment.

22. Since he gains \$1.50 on \$4.50, he gains $\frac{1}{3}$, or $33\frac{1}{3}\%$, of the cost.

23. Since the book was sold at a gain of 20%, or $\frac{1}{5}$, of the cost, 90¢ must have been 120%, or $\frac{6}{5}$, of the cost. The cost was, therefore, 75¢. If it had been sold for \$1, the gain would have been 25¢, and since the cost was 75¢, the gain would have been $\frac{1}{3}$, or $33\frac{1}{3}\%$, of the cost.

24. Since his commission was $3\frac{1}{5}\%$, or $\frac{1}{10}$, of the sales, the sum received was $\frac{11}{10}$ of \$870, or \$29.

25. Since his commission was \$60 on \$150, it was $\frac{2}{5}$, or $\frac{40}{100}\%$, of the sales.

26. Since his commission was 2% of the selling price, \$120 must have been 2% of the price received for the house. The price was, therefore, \$6000.

27. Since the stockholder owns 20 shares, or \$2000 worth of the stock, he will receive as a dividend $12\frac{1}{2}\%$, or $\frac{1}{8}$, of \$2000, or \$250.

Page 298.

28. Since the sum received by the agent contained the cost of the peaches and 8% additional for his commission, \$324 must have been 108% of the cost of the peaches. Therefore the peaches cost \$300.

29. Since the house was insured for only $\frac{2}{3}$ of its value, it was insured for only $\frac{2}{3}$ of \$6000, or \$4000, and since the rate was $1\frac{1}{4}\%$, the entire premium was $1\frac{1}{4}\%$ of \$4000, or \$50.

30. The interest for 1 yr. is \$18, and the interest for 3 yr. 4 mo., or $3\frac{1}{3}$ yr., is $3\frac{1}{3}$ times \$18, or \$60.

REVIEW EXERCISES—WRITTEN.

- $34\frac{1}{2}\%$ of the number of inhabitants = 16,767 ;
1% of the number of inhabitants = 486 ;
the whole number of inhabitants = 100 times 486, or 48,600.
- $62\frac{1}{2}\%$ of his money = \$8160 ; 1% of his money = \$130.56 ;
his money = 100 times \$130.56, or \$13,056.

Since he was worth \$13,056 and spent \$8160, he had left \$13,056 - \$8160, or \$4896.

3. $112\frac{1}{2}\%$ of the cost = \$6300 ; 1% of the cost = \$56 ;
the entire cost = 100 times \$56, or \$5600.

4. 115% of the cost = \$20,125 ; 1% of the cost = \$175 ;
the entire cost = 100 times \$175, or \$17,500.

5. $\$900 - (\$250 + \$100) = \550 , amount saved ;
 $\$550 = \frac{550}{500}$ of his salary, or $61\frac{1}{3}\%$ of his salary.

6. $\$4.50 \times 6000 = \$27,000$, cost of flour ;
 30% of 6000 bbl. = 1800 bbl. ;
 $\$4.50 \times 1.10 = \4.95 , selling price per barrel of first lot ;
 $\$4.95 \times 1800 = \8910 , selling price of first lot ;
 50% of 4200 bbl. = 2100 bbl. ;
 $\$4.50 \times 1.12\frac{1}{2} = \5.0625 , selling price per barrel of second lot ;
 $\$5.0625 \times 2100 = \$10,631.25$, selling price of second lot ;
 $\$5 \times 2100 = \$10,500$, selling price of third lot ;
 $\$8910 + \$10,631.25 + \$10,500 = \$30,041.25$, amount received
for all ;
 $\$30,041.25 - \$27,000 = \$3041.25$, gain.

7. Since the sum bequeathed to his wife, \$4500, was $62\frac{1}{2}\%$, or $\frac{5}{8}$,
of the sum bequeathed to his children, the sum bequeathed to his
children was \$7200 ; $\$7200 + \$4500 = \$11,700$, the sum bequeathed
to his wife and children. Since \$11,700 was 75% , or $\frac{3}{4}$, of the value
of the estate, the value of the estate was 4 times $\frac{1}{4}$ of \$11,700, or
\$15,600 ; $\$4500 \div \$15,600 = .28\frac{1}{3}$, or $28\frac{1}{3}\%$, of the estate, his wife's
share.

8. $\$175.50 - (\$145 + \$11) = \19.50 , gain per head ;
 $\$19.50 \div \$156 = .12\frac{1}{2}$, or $12\frac{1}{2}\%$, gain.

Page 299.

9. $\$5346 - \$4860 = \$486$, gain ;
 $\$486 \div \$4860 = .10$, or 10% , gain per cent.

10. $101\frac{1}{2}\%$ of the sum expended for cotton = \$12,180 ;
 1% of the sum expended = \$120 ;
the entire sum expended = 100 times \$120, or \$12,000 ;
 $\$12,180 - \$12,000 = \$180$, commission.

11. $\$1.60 \times 800 = \1280 , cost of carpeting ;
 $\$1280 + 1\frac{1}{4}\%$ of $\$1280 = \1302.40 , entire cost.
12. 7% of $\$76,500 = \5355 , dividend ;
 $\$5355 + \$2500 = \$7855$, net earnings.
13. $\$306 + \$13,600 = .02\frac{1}{4}$, or $2\frac{1}{4}\%$, rate of premium.
14. $\$225 + .01\frac{1}{2} = \$15,000$, sum for which it was insured.
15. $98\frac{1}{4}\%$ of the face of the policy = $\$12,360$;
 1% of the face of the policy = $\$125.8015$;
the face of the policy = 100 times $\$125.80152$, or $\$12,580.15$.
16. 640 polls @ $\$1.50$ each = $\$960$, poll tax ;
 $\$10,400 - \$960 = \$9440$, amount to be levied upon property ;
 $\$9440 \div \$2,360,000 = .004$, rate of taxation.
17. 300 lb. \times 30 = 9000 lb. ; 9000 lb. @ 32¢ = $\$2880$;
250 lb. \times 25 = 6250 lb. ; 6250 lb. @ 30¢ = $\$1875$;
 $\$2880 + \$1875 = \$4755$, invoiced price of goods ;
 20% of $\$4755 = \951 , duty.
18. Since he paid $\frac{1}{8}\%$ brokerage for buying and selling, the stock cost him $90\frac{1}{8}$, and he sold it for $94\frac{3}{8}$ net, realizing a gain of $4\frac{1}{2}\%$; $4\frac{1}{2}\%$ of $\$6500 = \292.50 , the gain.
19. The interest of $\$160$ @ 6% for 2 yr. 8 mo. 7 da. = $\$25.79$;
 $\$160 + \$25.79 = \$185.79$, amount.
20. $\$315.25 \div \$.015 = 21,016.67$; therefore the assessed valuation was $\$21,016.67$.

Page 300.

21. Interest of $\$300$ for 4 yr. at $6\% = \$72$;
interest of $\$300$ for 1 yr. at $6\% = \$18$;
interest of $\$18$ for 3 yr. + 2 yr. + 1 yr., or 6 yr., at $6\% = \$6.48$;
 $\$300 + \$72 + \$6.48 = \378.48 , amount due.

102 A KEY TO THE STANDARD ARITHMETIC.

22. $\$1.191016 =$ amount of $\$1$ for 3 yr. at 6% ;

.050022 = interest for 8 mo. 12 da. ;

$\$1.241038 \div$ amount of $\$1$ for 3 yr. 8 mo. 12 da. at 6% ;
750

$\$930.78,$ = amount of principal for 3 yr. 8 mo. 12 da. at 6%.

$\$930.78 - \$750 = \$180.78$ compound interest.

23. The interest on $\$1$ at 6% for 9 mo. 18 da. = $\$.048$; therefore it will take as many dollars to yield $\$13.50$ interest for the same time as $\$.048$ is contained times in $\$13.50$, which is 281.25 times ; therefore the principal is $\$281.25$.

24. The bank discount of $\$560$ for 2 yr. 6 mo. = $\$84$;

$\$560 - \$84 = \$476$, proceeds ;

the amount of $\$1$ for 2 yr. 6 mo. at 6% is $\$1.15$;

$\$560 \div \$1.15 = 486.96$. Therefore the present worth is $\$486.96$.

$\$486.96 - \$84 = \$402.96$, the difference.

25. $\$.95 \times 6000 = \5700 , cost of wheat ;

$\$5700 \times 1.03\frac{1}{2} = \5899.50 , selling price ;

$\$5899.50 =$ face of note discounted at a bank ;

$\$5899.50 \times .0055 = \32.45 , bank discount ;

$\$5899.50 - \$32.45 = \$5867.05$, proceeds ;

$\$5867.05 - \$5700 = \$167.05$, cash gain.

26. $\$420 - 30\%$ of $\$420 = \294 ; $\$294 - 10\%$ of $\$294 = \264.60 ;

$\$264.60 + \$6.50 + \$2.75 = \273.85 , cost.

27. Since $\$4.50$ was the net cost after the last discount, $\$4.50$ must have been 90%, or $\frac{9}{10}$, of the price before that deduction ; the price before the last deduction was, therefore, $\$5.00$. Since $\$5.00$ was the price after the first discount, $\$5.00$ must have been 60%, or $\frac{3}{5}$, of the list price ; therefore the list price was 10 times $\frac{1}{3}$ of $\$5.00$, or $\$8.33\frac{1}{3}$.

28. 300 bbl. at $\$20$ per barrel = $\$6000$;

$\$.40 \times 300 = \120 , freight ;

$\frac{1}{4}\%$ of $\$6000 = \15 , insurance ;

$2\frac{1}{4}\%$ of $\$6000 = \150 , commission ;

$\$120 + \$15 + \$150 = \285 , expenses ;

$\$6000 - \$285 = \$5715$, net proceeds.

29. The bank discount of \$1 for 3 mo. 3 da. at 6% = \$.0155;
 \$1 - \$.0155 = \$.9845, proceeds of \$1;
 \$354.42 ÷ \$.9845 = \$360. Therefore \$360 is the face of note.
30. $\frac{2}{3}$ of \$24,000 = \$16,000;
 \$16,000 × 1.33 $\frac{1}{3}$ = \$21,333; *← 21,333 ✓*
 $\frac{1}{3}$ of \$24,000 = \$8,000;
 \$8,000 × .0155 = \$124, bank discount;
 \$8,000 - \$124 = \$7,876, proceeds;
 (\$21,333 + \$7,876) - \$24,000 = \$5,209, gain;
 \$5,209 ÷ \$24,000 = .2170, or 21.70%, rate of gain.
31. The par value of 144 shares of stock = \$14,400;
 5% of \$14,400 = \$720, first income;
 \$14,400 ÷ \$120 = 120, the number of shares of Mich. 7's;
 7% of \$12,000 = \$840, second income;
 \$840 - \$720 = \$120, gain by change.

DOMESTIC EXCHANGE.

Page 304.

3. \$1 + \$.00 $\frac{1}{2}$ = \$1.00 $\frac{1}{2}$, cost of \$1 of draft;
 \$1.00 $\frac{1}{2}$ × \$1200 = \$1209, cost of draft.
4. \$1 - \$.00 $\frac{2}{3}$ = \$.99 $\frac{1}{3}$, cost of \$1 of draft;
 \$.99 $\frac{1}{3}$ × \$1500 = \$1494.375, cost of draft.
5. \$1 + \$.00 $\frac{2}{3}$ = \$1.00 $\frac{2}{3}$, cost of \$1 of draft;
 \$1.00 $\frac{2}{3}$ × 800 = \$805, cost of draft.
6. \$1 + \$.00 $\frac{1}{2}$ = \$1.00 $\frac{1}{2}$, cost of \$1 if paid at sight;
 the bank discount of \$1 for 2 mo. 3 da. @ 8% = \$.014;
 \$1.0025 - \$.014 = \$.9885, cost of \$1 of draft;
 \$.9885 × \$1600 = \$1581.60, cost of draft.
7. \$1 + \$.00 $\frac{1}{2}$ = \$1.00 $\frac{1}{2}$, cost of \$1 if paid at sight;
 the bank discount of \$1 for 33 da. @ 6% = \$.0055;
 \$1.00125 - \$.0055 = \$.99575, cost of \$1 of draft;
 \$.99575 × 475 = \$472.98, cost of draft.

Page 305.

8. $\$1 - \$.00\frac{2}{3} = \$.99625$, cost of $\$1$ if paid at sight;
 the bank discount of $\$1$ for 93 da. @ 6% = $\$.0155$;
 $\$.99625 - \$.0155 = \$.98075$, cost of $\$1$ of draft;
 $\$.98075 \times 600 = \588.45 , cost of draft.
9. $\$1 + \$.00125 = \$1.00125$, cost of $\$1$ of draft if paid at sight;
 the bank discount of $\$1$ for 63 da. @ 7% = $\$.01225$;
 $\$1.00125 - \$.01225 = \$.989$, cost of $\$1$ of draft;
 $\$.989 \times 900 = \890.10 , cost of draft.
10. $\$1 - \$.01\frac{1}{2} = \$.985$, cost of $\$1$ of draft if paid at sight;
 $\$.014 =$ bank discount on $\$1$ for 63 da. @ 8%;
 $\$.985 - \$.014 = \$.971$, cost of $\$1$ of draft;
 $\$.971 \times 1200 = \1165.20 , cost of draft.
11. $\$1 + \$.00\frac{2}{3} = \$1.00\frac{2}{3}$, cost of $\$1$ of draft if paid at sight;
 the bank discount of $\$1$ for 33 da. @ 4% = $\$.00366\frac{2}{3}$;
 $\$1.00625 - \$.00366\frac{2}{3} = \$1.00258\frac{1}{3}$, cost of $\$1$ of draft;
 $\$1.00258\frac{1}{3} \times 550 = \551.42 , cost of draft.
12. $\$1 - .01\frac{1}{2} = \$.9875$, cost of $\$1$ if paid at sight;
 the bank discount of $\$1$ for 93 da. @ 7% = $\$.0180\frac{1}{2}$;
 $\$.9875 - \$.0180\frac{1}{2} = \$.9694\frac{1}{2}$, cost of $\$1$ of draft;
 $\$.9694\frac{1}{2} \times 1750 = \1696.48 , cost of draft.
15. $\$1 + \$.00\frac{3}{4} = \$1.0075$, cost of $\$1$ of draft;
 $\$2800 \div \$1.0075 = 2779.16$, or $\$2779.16$ is the face of draft.
16. $\$1 + \$.01\frac{1}{2} = \$1.0125$, cost of $\$1$ of draft;
 $\$1260 \div \$1.0125 = 1244.44$, or $\$1244.44$ is the face of draft.

Page 306.

17. $\$1 - \$.00\frac{2}{3} = \$.99375$, cost of $\$1$ of draft;
 $\$1800 \div \$.99375 = 1811.32$, or $\$1811.32$ is the face of draft.

18. $\$1 + \$.01 = \$1.01$, cost of $\$1$ of draft at sight ;
 $\$.0055 =$ the bank discount of $\$1$ for 33 da. @ 6% ;
 $\$1.01 - \$.0055 = \$1.0045$, cost of $\$1$ of draft ;
 $\$2000 \div \$1.0045 = 1991.04$, or $\$1991.04$ is the face of draft.
19. $\$1 + \$.01\frac{1}{2} = \$1.0125$, cost of $\$1$ of draft at sight ;
 $\$.0105 =$ the bank discount of $\$1$ for 63 da. @ 6% ;
 $\$1.0125 - \$.0105 = \$1.002$, cost of $\$1$ of draft ;
 $\$650 \div \$1.002 = 648.70$, or $\$648.70$ is the face of the draft.
20. $\$1 - \$.00\frac{1}{2} = \$.99125$, cost of $\$1$ of draft at sight ;
 $\$.99125 - \$.01808\frac{1}{3} = \$.97316\frac{2}{3}$, cost of $\$1$ of draft ;
 $\$1000 \div \$.97316\frac{2}{3} = 1027.57$, or $\$1027.57$ is the face of the draft.

FOREIGN EXCHANGE.

Page 307.

3. $\pounds 425 \text{ 8s.} = \pounds 425.4$;
 $\$4.87\frac{1}{2} \times 425.4 = \2073.83 , cost of bill of exchange.
4. $\pounds 317 \text{ 9s.} = \pounds 317.45$;
 $\$4.90\frac{1}{2} \times 317.45 = \1557.09 , cost of bill of exchange.
5. $\$1950 + \$4.86\frac{3}{4} = 400.6849$;
 therefore $\$1950 = \pounds 400.6849$, or $\pounds 400 \text{ 13s. 8 + d.}$, face of draft.
6. $\$2875.80 + \$4.87\frac{1}{2} = 589.9076$;
 therefore $\$2875.80 = \pounds 589.9076$, or $\pounds 589 \text{ 18s. 1 + d.}$, face of bill of exchange.
7. $\$4000 + \$4.865 = 822.1994$;
 therefore $\$4000 = \pounds 822.1994$, or $\pounds 822 \text{ 3s. 11 + d.}$, face of bill of exchange.
8. $5000\text{f.} + 5.16\text{f.} = 968.99$;
 therefore $5000\text{f.} = \$968.99$, cost of bill of exchange.
9. $7865\text{f.} + 5.18\text{f.} = 1518.34$;
 therefore $7865\text{f.} = \$1518.34$, cost of bill of exchange.
10. $\$.95 \div 4 = \$.23\frac{1}{4}$, value of one mark ;
 $\$.23\frac{1}{4} \times 5344 = \1269.20 , cost of bill of exchange.

PARTNERSHIP.

Page 309.

2. $\$8000 + \$4500 + \$3500 = \$16,000$, entire capital ;
 $\frac{8000}{16000}$, or $\frac{1}{2}$, of $\$3200 = \1600 , A's share of gain ;
 $\frac{4500}{16000}$, or $\frac{9}{32}$, of $\$3200 = \900 , B's share of gain ;
 $\frac{3500}{16000}$, or $\frac{7}{32}$, of $\$3200 = \700 , C's share of gain.
3. $\$4500 + \$5400 + \$4200 = \$14,100$, entire capital ;
 $\frac{4500}{14100}$, or $\frac{15}{47}$, of $\$2400 = \765.96 , A's share of loss ;
 $\frac{5400}{14100}$, or $\frac{18}{47}$, of $\$2400 = \919.15 , B's share of loss ;
 $\frac{4200}{14100}$, or $\frac{14}{47}$, of $\$2400 = \714.89 , C's share of loss.
4. $\$6000 + \$9600 + \$6400 = \$22,000$, entire capital ;
 $\$30,000 - \$22,000 = \$8000$;
 $\$8000 + \$4800 = \$12,800$, entire gain ;
 $\frac{6000}{12800}$, or $\frac{3}{11}$, of $\$12,800 = \3490.91 , A's share of gain ;
 $\frac{9600}{12800}$, or $\frac{3}{4}$, of $\$12,800 = \5585.45 , B's share of gain ;
 $\frac{4400}{12800}$, or $\frac{11}{32}$, of $\$12,800 = \3723.64 , C's share of gain.

Page 310.

5. $\$5625 + \$5250 + \$7125 + \$6000 = \$24,000$, entire capital ;
 $\frac{5625}{24000}$, or $\frac{5}{48}$, of $\$6960 = \1631.25 , A's share of profit ;
 $\frac{5250}{24000}$, or $\frac{7}{32}$, of $\$6960 = \1522.50 , B's share of profit ;
 $\frac{7125}{24000}$, or $\frac{9}{32}$, of $\$6960 = \2066.25 , C's share of profit ;
 $\frac{6000}{24000}$, or $\frac{1}{4}$, of $\$6960 = \1740 , D's share of profit.
6. $\$5500 + \$6500 + \$4500 = \$16,500$, entire capital ;
 C's capital = $\frac{4500}{16500}$, or $\frac{3}{11}$, of entire capital ;
 therefore C would be entitled to $\frac{3}{11}$ of entire gain ;
 $\frac{3}{11}$ of gain = $\$1500$; $\frac{1}{11}$ of gain = $\$500$; entire gain = $\$5500$;
 $\frac{5500}{16500}$, or $\frac{1}{3}$, of $\$5500 = \$1833\frac{1}{3}$, A's share of gain ;
 $\frac{6500}{16500}$, or $\frac{13}{33}$, of $\$5500 = \$2166\frac{2}{3}$, B's share of gain.

7. $\frac{2}{3}$ of \$8190 = \$5460, A's share of 1st year's profits;
 $\frac{1}{3}$ of \$8190 = \$2730, B's share of 1st year's profits;
 $\frac{3}{4}$ of \$8190 = \$6142.50, B's share of 2d year's profits;
 $\frac{1}{4}$ of \$8190 = \$2047.50, A's share of 2d year's profits;
 \$5460 + \$2047.50 = \$7507.50, A's total profit;
 \$2730 + \$6142.50 = \$8872.50, B's total profit.
8. \$30,000 - (\$6000 + \$7000 + \$8000) = \$9000, H's capital;
 18% of \$30,000 = \$5400, entire gain;
 $\frac{4000}{30000}$, or $\frac{1}{7.5}$, of \$5400 = \$720, E's share of gain;
 $\frac{7000}{30000}$, or $\frac{7}{30}$, of \$5400 = \$1260, F's share of gain;
 $\frac{8000}{30000}$, or $\frac{4}{15}$, of \$5400 = \$1440, G's share of gain;
 $\frac{3000}{30000}$, or $\frac{1}{10}$, of \$5400 = \$540, H's share of gain.
9. \$10,000 + \$15,000 + \$25,000 = \$50,000, the entire capital;
 $\frac{10000}{50000}$, or $\frac{1}{5}$, of \$6250 = \$1250, A's share of gain;
 $\frac{15000}{50000}$, or $\frac{3}{10}$, of \$6250 = \$1875, B's share of gain;
 $\frac{25000}{50000}$, or $\frac{1}{2}$, of \$6250 = \$3125, C's share of gain.

Page 311.

11. \$2800 \times 10 = \$28,000, A's capital for one month;
 3200 \times 12 = 38,400, B's capital for one month;
 4000 \times 8 = 32,000, C's capital for one month;
 \$98,400, entire capital for one month.
- $\frac{28000}{98400}$, or $\frac{35}{123}$, of \$2952 = \$840, A's gain;
 $\frac{38400}{98400}$, or $\frac{48}{123}$, of \$2952 = \$1152, B's gain;
 $\frac{32000}{98400}$, or $\frac{40}{123}$, of \$2952 = \$960, C's gain.
12. \$1200 \times 4 = \$4,800 }
 2000 \times 8 = 16,000 } = \$20,800, A's capital for 1 month;
 1000 \times 6 = 6,000 }
 800 \times 6 = 4,800 } = \$10,800, B's capital for 1 month;
 \$31,600, entire capital for 1 month.
- $\frac{10800}{31600}$, or $\frac{27}{79}$, of \$1580 = \$1040, A's loss;
 $\frac{10800}{31600}$, or $\frac{27}{79}$, of \$1580 = \$540, B's loss.

108 A KEY TO THE STANDARD ARITHMETIC.

13. Since 2 horses eat as much as 3 oxen, B's 12 oxen will eat as much as 8 horses; and since 3 oxen eat as much as 5 cows, C's 40 cows will eat as much as 24 oxen, and as much as 16 horses; therefore

$$6 \text{ horses for 8 weeks} = 48 \text{ horses for 1 week;}$$

$$8 \text{ horses for 10 weeks} = 80 \text{ horses for 1 week;}$$

$$16 \text{ horses for 12 weeks} = 192 \text{ horses for 1 week;}$$

$$320 = \text{entire number for 1 week.}$$

$$\frac{48}{320}, \text{ or } \frac{3}{20}, \text{ of } \$128 = \$19.20, \text{ A's share of rent;}$$

$$\frac{80}{320}, \text{ or } \frac{1}{4}, \text{ of } \$128 = \$32.00, \text{ B's share of rent;}$$

$$\frac{192}{320}, \text{ or } \frac{3}{5}, \text{ of } \$128 = \$76.80, \text{ C's share of rent.}$$

14. $\$800 \div 4 = \200 , A's gain for 1 month;

$$1000 \div 5 = 200, \text{ B's gain for 1 month;}$$

$$1200 \div 12 = 100, \text{ C's gain for 1 month;}$$

$$\$500, \text{ entire gain for 1 month.}$$

Since each man's share of the monthly gain is proportionate to his share of the capital, therefore

$$\frac{3000}{15000}, \text{ or } \frac{1}{5}, \text{ of } \$25,675 = \$5,135, \text{ A's capital;}$$

$$\frac{3000}{15000}, \text{ or } \frac{1}{5}, \text{ of } \$25,675 = \$5,135, \text{ B's capital;}$$

$$\frac{9000}{15000}, \text{ or } \frac{3}{5}, \text{ of } \$25,675 = \$15,405, \text{ C's capital.}$$

15. $400 \times 4 = 1600$ } = 2400, D's sheep for 1 month;
 $200 \times 4 = 800$ }

$$320 \times 4 = 1280$$
 } = 1920, E's sheep for 1 month;
 $160 \times 4 = 640$ }

$$240 \times 4 = 960, \text{ F's sheep for 1 month;}$$

$$2400 + 1920 + 960 = 5280, \text{ entire number for 1 month.}$$

$$\frac{1600}{5280}, \text{ or } \frac{5}{164}, \text{ of } \$480 = \$29.27, \text{ D's share of rent;}$$

$$\frac{1280}{5280}, \text{ or } \frac{4}{164}, \text{ of } \$480 = \$22.08, \text{ E's share of rent;}$$

$$\frac{960}{5280}, \text{ or } \frac{3}{164}, \text{ of } \$480 = \$8.72, \text{ F's share of rent.}$$

Page 319.

13. $2\frac{1}{2}$ bbl. : $7\frac{1}{2}$ bbl. :: \$ 20.75 : ?

$$\frac{\$ 20.75 \times 7\frac{1}{2}}{2\frac{1}{2}} = \$ 56.50.$$

14. 1 yd. in width : $\frac{3}{4}$ yd. in width :: 42 yd. : ?

$$\frac{42 \text{ yd.} \times 3}{4} = 31\frac{1}{2} \text{ yd.}$$

15. Since 30 men can finish digging the ditch in 8 da., how many men can finish it in 6 da. ?

6 da. : 8 da. :: 30 men : ?

$$\frac{30 \text{ men} \times 8}{6} = 40 \text{ men.}$$

Therefore, since 40 men will be required to finish the work, 10 more men must be employed.

16. $4\frac{1}{2}$ ft. : $46\frac{1}{2}$ ft. :: $5\frac{3}{4}$ ft. : ?

$$\frac{5\frac{3}{4} \text{ ft.} \times 46\frac{1}{2}}{4\frac{1}{2}} = 58\frac{3}{4} \text{ ft.}$$

17. Since it gains $\frac{6}{20}$ of a revolution in making 1 revolution, how many revolutions must it make to gain 12 revolutions ?

$\frac{6}{20}$: 12 :: 1 revolution : ?

$$\frac{1 \text{ rev.} \times 12}{\frac{6}{20}} = 40 \text{ revolutions.}$$

Or, since it gains 6 cogs in making 1 revolution, how many revolutions must it make to gain (20 cogs \times 12) 240 cogs ?

6 cogs : 240 cogs :: 1 revolution : ?

$$\frac{1 \text{ rev.} \times 240}{6} = 40 \text{ revolutions.}$$

18. Since 15 men can do the work in 36 da., in what time can 24 men do it ?

24 men : 15 men :: 36 da. : ?

$$\frac{36 \text{ da.} \times 15}{24} = 22\frac{1}{2} \text{ da.}$$

19. Since 25 men can finish the work in 22 da., how long will it take 12 men to finish it?

$$12 \text{ men} : 25 \text{ men} :: 22 \text{ da.} : ?$$

$$\frac{22 \text{ da.} \times 25}{12} = 45\frac{5}{6} \text{ da.}$$

20. Since the provisions left at the end of 5 mo. would last 200 men 3 mo., the problem reduces to this:

If the provisions will last 200 men for 3 mo., how many men will they last 8 mo.?

$$8 \text{ mo.} : 3 \text{ mo.} :: 200 \text{ men} : ?$$

$$\frac{200 \text{ men} \times 3}{8} = 75 \text{ men.}$$

Since the provisions will supply only 75 men for the remainder of the time, 125 must leave.

21. 675 pages : 900 pages :: 15 da. : ?

$$\frac{15 \text{ da.} \times 900}{675} = 20 \text{ da.}$$

22. 444 mi. : 1060 mi. :: 8 $\frac{1}{4}$ hr. : ?

$$\frac{8\frac{1}{4} \text{ hr.} \times 1060}{444} = 20 \text{ hr. } 41.44 \text{ min.}$$

23. 1 $\frac{1}{8}$ acres : 7 $\frac{1}{4}$ acres :: 405 bu. : ?

$$\frac{405 \text{ bu.} \times 7\frac{1}{4}}{1\frac{1}{8}} = 2711\frac{1}{4} \text{ bu.}$$

24. A train runs 35 $\frac{1}{4}$ miles in 1 hr.; how far will it run in 6 hr. 5 min.?

$$1 \text{ hr.} : 6\frac{1}{2} \text{ hr.} :: 35\frac{1}{4} \text{ mi.} : ?$$

$$\frac{35\frac{1}{4} \text{ mi.} \times 6\frac{1}{2}}{1} = 214\frac{7}{8} \text{ mi.}$$

COMPOUND PROPORTION.

Page 321.

2. 45 rods : 81 rods }
 12 da. : 6 da. } :: 11 men : ?
 11 hr. : 10 hr. }

$$\frac{11 \text{ men} \times 81 \times 6 \times 10}{45 \times 12 \times 11} = 9 \text{ men.}$$

112 A KEY TO THE STANDARD ARITHMETIC

$$\left. \begin{array}{l} 3. \quad 5 \text{ workmen} : 3 \text{ workmen} \\ 20 \text{ rods} \quad : 45 \text{ rods} \\ 3 \text{ ft.} \quad : 4 \text{ ft.} \end{array} \right\} :: 10 \text{ da.} : ?$$

$$\frac{10 \text{ da.} \times 3 \times 45 \times 4}{5 \times 20 \times 3} = 18 \text{ da.}$$

$$\left. \begin{array}{l} 4. \quad 4 \text{ da.} : 12 \text{ da.} \\ 1 \quad : 4 \end{array} \right\} :: 18 \text{ men} : ?$$

$$\frac{18 \text{ men} \times 12 \times 4}{4 \times 1} = 216 \text{ men.}$$

$$\left. \begin{array}{l} 5. \quad 125 \text{ cattle} : 275 \text{ cattle} \\ 900 \text{ lb.} \quad : 1200 \text{ lb.} \\ 150 \text{ mi.} \quad : 225 \text{ mi.} \end{array} \right\} :: \$200 : ?$$

$$\frac{\$200 \times 275 \times 1200 \times 225}{125 \times 900 \times 150} = \$880.$$

$$\left. \begin{array}{l} 6. \quad 7 \text{ ft. long} : 10 \text{ ft. long} \\ 3 \text{ ft. wide} : 4 \text{ ft. wide} \\ 2 \text{ ft. thick} : 3 \text{ ft. thick} \end{array} \right\} :: 6930 \text{ lb.} : ?$$

$$\frac{6930 \text{ lb.} \times 10 \times 4 \times 3}{7 \times 3 \times 2} = 19,800 \text{ lb.}$$

$$\left. \begin{array}{l} 7. \quad 24 \text{ ft. long} : 16 \text{ ft. long} \\ 4\frac{1}{2} \text{ ft. wide} : 5 \text{ ft. wide} \\ 4\frac{2}{3} \text{ ft. deep} : 4\frac{1}{2} \text{ ft. deep} \end{array} \right\} :: 405 \text{ bu.} : ?$$

$$\frac{405 \text{ bu.} \times 16 \times 5 \times 4\frac{1}{2}}{24 \times 4\frac{1}{2} \times 4\frac{2}{3}} = 289\frac{2}{3} \text{ bu.}$$

$$\left. \begin{array}{l} 8. \quad 60 \text{ ft. long} : 200 \text{ ft. long} \\ 14 \text{ ft. high} : 18 \text{ ft. high} \\ 1\frac{1}{2} \text{ ft. thick} : 1\frac{1}{2} \text{ ft. thick} \end{array} \right\} :: \$180 : ?$$

$$\frac{\$180 \times 200 \times 18 \times 1\frac{1}{2}}{60 \times 14 \times 1\frac{1}{2}} = \$685.71.$$

Page 322.

9. Since 5 men can do as much work as 7 boys, 25 men can do as much as 35 boys.

$$\left. \begin{array}{l} 25 \text{ men} : 15 \text{ men} \\ 10 \text{ hr.} : 12 \text{ hr.} \\ 60 \text{ acres} : 90 \text{ acres} \end{array} \right\} :: 20 \text{ da.} : ?$$

$$\frac{20 \text{ da.} \times 15 \times 12 \times 90}{25 \times 10 \times 60} = 21\frac{1}{3} \text{ da.}$$

$$\left. \begin{array}{l} 10. \quad 8 \text{ men} : 16 \text{ men} \\ 40 \text{ ft. long} : 30 \text{ ft. long} \\ 36 \text{ ft. wide} : 27 \text{ ft. wide} \\ 8 \text{ ft. deep} : 6 \text{ ft. deep} \\ 10 \text{ hr.} : 8 \text{ hr.} \end{array} \right\} :: 12 \text{ da.} : ?$$

$$\frac{12 \text{ da.} \times 16 \times 30 \times 27 \times 6 \times 8}{8 \times 40 \times 36 \times 8 \times 10} = 8\frac{1}{10} \text{ da.}$$

$$\left. \begin{array}{l} 11. \quad 5 \text{ bars} : 20 \text{ bars} \\ 4 \text{ ft. long} : 6 \text{ ft. long} \\ 3 \text{ in. broad} : 2\frac{1}{2} \text{ in. broad} \\ 2 \text{ in. thick} : 1\frac{1}{4} \text{ in. thick} \end{array} \right\} :: 240 \text{ lb.} : ?$$

$$\frac{240 \text{ lb.} \times 20 \times 6 \times 2\frac{1}{2} \times 1\frac{1}{4}}{5 \times 4 \times 3 \times 2} = 750 \text{ lb.}$$

$$\left. \begin{array}{l} 12. \quad 12 \text{ bricklayers} : 9 \text{ bricklayers} \\ 80 \text{ ft. long} : 100 \text{ ft. long} \\ 20 \text{ ft. high} : 25 \text{ ft. high} \\ 1\frac{1}{2} \text{ ft. thick} : 2 \text{ ft. thick} \\ 10 \text{ hr.} : 9 \text{ hr.} \end{array} \right\} :: 15 \text{ da.} : ?$$

$$\frac{15 \text{ da.} \times 9 \times 100 \times 25 \times 2 \times 9}{12 \times 80 \times 20 \times 1\frac{1}{2} \times 10} = 21\frac{3}{4} \text{ da.}$$

114 A KEY TO THE STANDARD ARITHMETIC.

$$\begin{array}{l}
 13. \quad 48 \text{ men} \quad : 240 \text{ men} \\
 \quad \quad 9 \text{ hr.} \quad : \quad 8 \text{ hr.} \\
 350 \text{ ft. long} : 500 \text{ ft. long} \\
 \quad \quad 11 \text{ ft. wide} : 16\frac{2}{3} \text{ ft. wide} \\
 \quad \quad 2\frac{1}{2} \text{ ft. deep} : 3\frac{1}{2} \text{ ft. deep}
 \end{array}
 \left.
 \begin{array}{l}
 \\
 \\
 \\
 \\
 \\
 \end{array}
 \right\} :: 11 \text{ da.} : ?$$

$$\frac{11 \text{ da.} \times 240 \times 8 \times 500 \times 16\frac{2}{3} \times 3\frac{1}{2}}{48 \times 9 \times 350 \times 11 \times 2\frac{1}{2}} = 158\frac{1}{3} \text{ da.}$$

$$\begin{array}{l}
 14. \quad 54 \text{ men} \quad : 112 \text{ men} \\
 28 \text{ da.} \quad : \quad 25 \text{ da.} \\
 10 \text{ hr.} \quad : \quad 8\frac{1}{2} \text{ hr.} \\
 2\frac{1}{2} \text{ yd. broad} : 2\frac{1}{2} \text{ yd. broad} \\
 1\frac{1}{2} \text{ yd. deep} : 1\frac{1}{2} \text{ yd. deep}
 \end{array}
 \left.
 \begin{array}{l}
 \\
 \\
 \\
 \\
 \end{array}
 \right\} :: 352 \text{ yd.} : ?$$

$$\frac{352 \text{ yd.} \times 112 \times 25 \times 8\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}}{54 \times 28 \times 10 \times 2\frac{1}{2} \times 1\frac{1}{2}} = 419\frac{1}{2} \text{ yd.}$$

$$\begin{array}{l}
 15. \quad 1 \text{ regiment} : 3 \text{ regiments} \\
 15 \text{ days} \quad : 12 \text{ days}
 \end{array}
 \left.
 \begin{array}{l}
 \\
 \end{array}
 \right\} :: 11,500 \text{ lb.} : ?$$

$$\frac{11,500 \text{ lb.} \times 3 \times 12}{1 \times 15} = 27,600 \text{ lb.}$$

$$\begin{array}{l}
 16. \quad 8 \text{ ft. long} : 10 \text{ ft. long} \\
 4 \text{ ft. wide} : 5 \text{ ft. wide} \\
 5 \text{ ft. deep} : 6 \text{ ft. deep}
 \end{array}
 \left.
 \begin{array}{l}
 \\
 \\
 \end{array}
 \right\} :: 10,000 \text{ lb.} : ?$$

$$\frac{10,000 \text{ lb.} \times 10 \times 5 \times 6}{8 \times 4 \times 5} = 18,750 \text{ lb.}$$

17. Since 5 horses eat as much as 6 cattle, 12 cattle will eat as much as 10 horses, and 15 cattle as much as $12\frac{1}{2}$ horses; therefore 8 horses and 12 cattle will eat as much as 18 horses, and 7 horses and 15 cattle as much as $19\frac{1}{2}$ horses.

$$\begin{array}{l}
 18 \text{ horses} : 19\frac{1}{2} \text{ horses} \\
 40 \text{ da.} \quad : 65 \text{ da.}
 \end{array}
 \left.
 \begin{array}{l}
 \\
 \end{array}
 \right\} :: 12 \text{ tons} : ?$$

$$\frac{12 \text{ tons} \times 19\frac{1}{2} \times 65}{18 \times 40} = 21\frac{1}{8} \text{ tons.}$$

PARTITIVE PROPORTION.

Page 323.

3. $2 + 5 + 7 = 14$; $\frac{2}{14}$ of 420 = 60; $\frac{5}{14}$ of 420 = 150;
 $\frac{7}{14}$ of 420 = 210. Therefore the parts are 60, 150, 210.
4. $1 + 2 + 3 + 4 + 5 = 15$; $\frac{1}{15}$ of 750 = 50; $\frac{2}{15}$ of 750 = 100;
 $\frac{3}{15}$ of 750 = 150; $\frac{4}{15}$ of 750 = 200; $\frac{5}{15}$ of 750 = 250.
 Therefore the parts are 50, 100, 150, 200, 250.
5. $\frac{1}{2}, \frac{1}{3}, \frac{1}{4} = \frac{6}{12}, \frac{4}{12}, \frac{3}{12}$; $6 + 4 + 3 = 13$; $\frac{6}{13}$ of 468 = 216;
 $\frac{4}{13}$ of 468 = 144; $\frac{3}{13}$ of 468 = 108.
 Therefore the parts are 216, 144, 108.
6. $\frac{1}{3}, \frac{2}{5}, \frac{1}{4} = \frac{20}{60}, \frac{24}{60}, \frac{15}{60}$; $40 + 45 + 48 = 133$; $\frac{20}{133}$ of \$1596 = \$480.
 $\frac{24}{133}$ of \$1596 = \$540; $\frac{15}{133}$ of \$1596 = \$576.
 Therefore the parts are \$480, \$540, \$576.
7. $\frac{1}{3}, \frac{2}{5}, \frac{1}{4} = \frac{20}{60}, \frac{24}{60}, \frac{15}{60}$; $168 + 175 + 180 = 523$;
 $\frac{20}{523}$ of \$26,150 = \$8400; $\frac{24}{523}$ of \$26,150 = \$8750;
 $\frac{15}{523}$ of \$26,150 = \$9000.
 Therefore the prices were \$8400, \$8750, \$9000.
8. As often as the wife receives \$7, the sons receive \$10, and the daughters \$12.
 $\$7 + \$10 + \$12 = \29 ;
 $\frac{7}{29}$ of \$250,000 = \$60,344.82, the wife's portion;
 $\frac{10}{29}$ of \$250,000 = \$86,206.90;
 $\$86,206.90 \div 2 = \$43,103.45$, each son's portion;
 $\frac{12}{29}$ of \$250,000 = \$103,448.28;
 $\$103,448.28 \div 3 = \$34,482.76$, each daughter's portion.

INVOLUTION.

Page 326.

2. $54^2 = 50^2 + 2(50 \times 4) + 4^2 = 2916$.
3. $71^2 = 70^2 + 2(70 \times 1) + 1^2 = 5041$.

4. $68^2 = 60^2 + 2(60 \times 8) + 8^2 = 4624.$

5. $47^2 = 40^2 + 2(40 \times 7) + 7^2 = 2209.$

6. $89^2 = 80^2 + 2(80 \times 9) + 9^2 = 7921.$

7. $26^2 = 20^2 + 2(20 \times 6) + 6^2 = 676.$

8. $74^2 = 70^2 + 2(70 \times 4) + 4^2 = 5476.$

9. $95^2 = 90^2 + 2(90 \times 5) + 5^2 = 9025.$

10. $82^2 = 80^2 + 2(80 \times 2) + 2^2 = 6724.$

11. $39^2 = 30^2 + 2(30 \times 9) + 9^2 = 1521.$

12. $44^2 = 40^2 + 2(40 \times 4) + 4^2 = 1936.$

13. $67^2 = 60^2 + 2(60 \times 7) + 7^2 = 4489.$

2. $27^3 = 20^3 + 3(20^2 \times 7) + 3(20 \times 7^2) + 7^3 = 19,683.$

3. $36^3 = 30^3 + 3(30^2 \times 6) + 3(30 \times 6^2) + 6^3 = 46,656.$

4. $29^3 = 20^3 + 3(20^2 \times 9) + 3(20 \times 9^2) + 9^3 = 24,389.$

5. $43^3 = 40^3 + 3(40^2 \times 3) + 3(40 \times 3^2) + 3^3 = 79,507.$

6. $51^3 = 50^3 + 3(50^2 \times 1) + 3(50 \times 1^2) + 1^3 = 132,651.$

7. $44^3 = 40^3 + 3(40^2 \times 4) + 3(40 \times 4^2) + 4^3 = 85,184.$

8. $46^3 = 40^3 + 3(40^2 \times 6) + 3(40 \times 6^2) + 6^3 = 97,336.$

9. $55^3 = 50^3 + 3(50^2 \times 5) + 3(50 \times 5^2) + 5^3 = 166,375.$

10. $64^3 = 60^3 + 3(60^2 \times 4) + 3(60 \times 4^2) + 4^3 = 262,144.$

11. $66^3 = 60^3 + 3(60^2 \times 6) + 3(60 \times 6^2) + 6^3 = 287,496.$

12. $58^3 = 50^3 + 3(50^2 \times 8) + 3(50 \times 8^2) + 8^3 = 195,112.$

13. $75^3 = 70^3 + 3(70^2 \times 5) + 3(70 \times 5^2) + 5^3 = 421,875.$

EVOLUTION.

Page 327.

2. The prime factors of 225 are 5, 5, 3, 3. Since the square root is sought, they are to be separated into two equal groups. Therefore 5×3 , or 15, is the square root of 225.

$1296 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3$. Therefore the square root is $2 \times 2 \times 3 \times 3$, or 36.

$2401 = 7 \times 7 \times 7 \times 7$. Therefore the square root is 7×7 , or 49.

3. $11,025 = 7 \times 7 \times 5 \times 5 \times 3 \times 3$. Therefore the square root is $7 \times 5 \times 3$, or 105.

$14,400 = 5 \times 5 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. Therefore the square root is $5 \times 3 \times 2 \times 2 \times 2$, or 120.

$48,656 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. Therefore the square root is $3 \times 3 \times 3 \times 2 \times 2 \times 2$, or 216.

4. The prime factors of 343 are 7, 7, 7. Since the cube root is sought, they are to be separated into three equal groups. Therefore 7 is the cube root of 343.

$1728 = 3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. Therefore $3 \times 2 \times 2$, or 12, is the cube root of 1728.

$15,625 = 5 \times 5 \times 5 \times 5 \times 5 \times 5$. Therefore 5×5 , or 25, is the cube root of 15,625.

5. $19,683 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$. The cube root = $3 \times 3 \times 3$, or 27.

$32,768 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. The cube root = $2 \times 2 \times 2 \times 2 \times 2$, or 32.

$74,088 = 7 \times 7 \times 7 \times 3 \times 3 \times 3 \times 2 \times 2 \times 2$. The cube root = $7 \times 3 \times 2$, or 42.

6. $65,536 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. The fourth root is found by separating the factors into four equal groups, and then taking one of them for the root. It is, therefore, $2 \times 2 \times 2 \times 2$, or 16.

$248,832 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. The fifth root is one of the five equal groups into which the factors may be separated. It is, therefore, $3 \times 2 \times 2$, or 12.

7. $331,776 = 3 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. The fourth root = $3 \times 2 \times 2 \times 2$, or 24.

$2,985,984 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$. The sixth root is one of the six equal groups of factors, $3 \times 2 \times 2$, or 12.

118 A KEY TO THE STANDARD ARITHMETIC.

SQUARE ROOT.

Page 331.

$$\begin{array}{r} 4. \quad 30\text{-}25 \overline{)55} \\ \underline{25} \\ 105 \overline{)525} \\ \underline{525} \end{array}$$

$$\begin{array}{r} 5. \quad 54\text{-}76 \overline{)74} \\ \underline{49} \\ 144 \overline{)576} \\ \underline{576} \end{array}$$

$$\begin{array}{r} 6. \quad 96\text{-}04 \overline{)98} \\ \underline{81} \\ 188 \overline{)1504} \\ \underline{1504} \end{array}$$

$$\begin{array}{r} 7. \quad 1\text{-}18\text{-}81 \overline{)109} \\ \underline{1} \\ 209 \overline{)1881} \\ \underline{1881} \end{array}$$

$$\begin{array}{r} 8. \quad 1\text{-}32\text{-}25 \overline{)115} \\ \underline{1} \\ 21 \overline{)32} \\ \underline{21} \\ 225 \overline{)1125} \\ \underline{1125} \end{array}$$

$$\begin{array}{r} 9. \quad 1\text{-}46\text{-}41 \overline{)121} \\ \underline{1} \\ 22 \overline{)46} \\ \underline{44} \\ 241 \overline{)241} \\ \underline{241} \end{array}$$

$$\begin{array}{r} 10. \quad 2\text{-}10\text{-}25 \overline{)145} \\ \underline{1} \\ 24 \overline{)110} \\ \underline{96} \\ 285 \overline{)1425} \\ \underline{1425} \end{array}$$

$$\begin{array}{r} 11. \quad 2\text{-}34\text{-}09 \overline{)158} \\ \underline{1} \\ 25 \overline{)134} \\ \underline{125} \\ 303 \overline{)909} \\ \underline{909} \end{array}$$

$$\begin{array}{r} 12. \quad 4\text{-}16\text{-}16 \overline{)204} \\ \underline{4} \\ 404 \overline{)1616} \\ \underline{1616} \end{array}$$

$$\begin{array}{r} 13. \quad 5\text{-}24\text{-}41 \overline{)229} \\ \underline{4} \\ 42 \overline{)124} \\ \underline{84} \\ 449 \overline{)4041} \\ \underline{4041} \end{array}$$

$$\begin{array}{r} 14. \quad 7\text{-}72\text{-}84 \overline{)278} \\ \underline{4} \\ 47 \overline{)372} \\ \underline{329} \\ 548 \overline{)4384} \\ \underline{4384} \end{array}$$

$$\begin{array}{r} 15. \quad 17\text{-}30\text{-}56 \overline{)416} \\ \underline{16} \\ 81 \overline{)130} \\ \underline{81} \\ 826 \overline{)4956} \\ \underline{4956} \end{array}$$

$$\begin{array}{r} 16. \quad 19\text{-}00\text{-}96 \overline{)48.6} \\ \underline{16} \\ 83 \overline{)300} \\ \underline{249} \\ 866 \overline{)5196} \\ \underline{5196} \end{array}$$

$$\begin{array}{r} 17. \quad .51\text{-}40\text{-}89 \overline{).717} \\ \underline{49} \\ 141 \overline{)240} \\ \underline{141} \\ 1427 \overline{)9989} \\ \underline{9989} \end{array}$$

$$\begin{array}{r} 18. \quad 97.81\text{-}21 \overline{)9.89} \\ \underline{81} \\ 188 \overline{)1681} \\ \underline{1504} \\ 1969 \overline{)17721} \\ \underline{17721} \end{array}$$

$$\begin{array}{r} 19. \quad .00\text{-}12\text{-}25 \overline{).035} \\ \underline{9} \\ 65 \overline{)325} \\ \underline{325} \end{array}$$

120 A KEY TO THE STANDARD ARITHMETIC.

27. $49,117\frac{1}{2}\frac{1}{2} = 49117.640625$

$4 \cdot 91 \cdot 17.64 \cdot 06 \cdot 25 \mid 221.625 \text{ or } 221\frac{1}{2}$

$$\begin{array}{r} 4 \\ 42 \overline{) 91} \\ \underline{84} \\ 441 \overline{) 717} \\ \underline{441} \\ 4426 \overline{) 27664} \\ \underline{26556} \\ 44322 \overline{) 110806} \\ \underline{88644} \\ 443245 \overline{) 2216225} \\ \underline{2216225} \end{array}$$

28. $5 \cdot 52 \cdot 25 \mid 285$

$$\begin{array}{r} 4 \\ 48 \overline{) 152} \\ \underline{120} \\ 465 \overline{) 2325} \\ \underline{2325} \\ 78 \cdot 49 \cdot 06 \mid 886 \\ 64 \\ 168 \overline{) 1449} \\ \underline{1344} \\ 1766 \overline{) 10596} \\ \underline{10596} \end{array}$$

Therefore $\sqrt{\frac{55225}{784996}} = \frac{111}{111}$.

29. $18 \mid 4.24264$

$$\begin{array}{r} 16 \\ 82 \overline{) 200} \\ \underline{164} \\ 844 \overline{) 3600} \\ \underline{3376} \\ 8482 \overline{) 22400} \\ \underline{16964} \\ 54360 \\ 50892 \\ \underline{34680} \\ 33928 \end{array}$$

30. $35 \mid 5.91607$

$$\begin{array}{r} 25 \\ 109 \overline{) 1000} \\ \underline{981} \\ 1181 \overline{) 1900} \\ \underline{1181} \\ 11826 \overline{) 71900} \\ \underline{70956} \\ 94400 \\ \underline{82782} \end{array}$$

31. $47 \mid 6.85565$

$$\begin{array}{r} 36 \\ 128 \overline{) 1100} \\ \underline{1024} \\ 1865 \overline{) 7600} \\ \underline{6825} \\ 13705 \overline{) 77500} \\ \underline{68525} \\ 89750 \\ \underline{82230} \\ 75200 \\ \underline{68525} \end{array}$$

32. $91 \mid 9.53939$

$$\begin{array}{r} 81 \\ 185 \overline{) 1000} \\ \underline{925} \\ 1903 \overline{) 7500} \\ \underline{5709} \\ 19069 \overline{) 179100} \\ \underline{171621} \\ 74790 \\ \underline{57207} \\ 176830 \\ \underline{171521} \end{array}$$

33. $1\cdot27 \overline{)11.26942}$

$$\begin{array}{r} 1 \\ \hline 21 \overline{)27} \\ \underline{21} \\ 600 \\ \underline{444} \\ 2246 \overline{)15800} \\ \underline{13476} \\ 22529 \overline{)212400} \\ \underline{202761} \\ 96390 \\ \underline{90116} \\ 62740 \\ \underline{45058} \end{array}$$

34. $2\cdot45 \overline{)15.65247}$

$$\begin{array}{r} 1 \\ \hline 25 \overline{)145} \\ \underline{125} \\ 308 \overline{)2000} \\ \underline{1836} \\ 3125 \overline{)16400} \\ \underline{15625} \\ 31302 \overline{)77500} \\ \underline{62804} \\ 148960 \\ \underline{125208} \\ 237520 \\ \underline{219114} \end{array}$$

35. $3\cdot70 \overline{)19.28538}$

$$\begin{array}{r} 1 \\ \hline 29 \overline{)270} \\ \underline{261} \\ 382 \overline{)900} \\ \underline{764} \\ 3843 \overline{)13600} \\ \underline{11529} \\ 38465 \overline{)207100} \\ \underline{192325} \\ 147750 \\ \underline{116895} \\ 328550 \\ \underline{307720} \end{array}$$

36. $8\cdot13 \overline{)28.51815}$

$$\begin{array}{r} 4 \\ \hline 48 \overline{)413} \\ \underline{384} \\ 565 \overline{)2900} \\ \underline{2825} \\ 5701 \overline{)7500} \\ \underline{5701} \\ 57023 \overline{)179900} \\ \underline{171089} \\ 88310 \\ \underline{57023} \\ 312870 \\ \underline{285115} \end{array}$$

37. $7\cdot25 \overline{)2.69258}$

$$\begin{array}{r} 4 \\ \hline 46 \overline{)325} \\ \underline{276} \\ 529 \overline{)4900} \\ \underline{4761} \\ 5382 \overline{)13900} \\ \underline{10764} \\ 31380 \\ \underline{26910} \\ 44500 \\ \underline{43056} \end{array}$$

38. $.52\cdot60 \overline{).72525}$

$$\begin{array}{r} 49 \\ \hline 142 \overline{)360} \\ \underline{284} \\ 1445 \overline{)7600} \\ \underline{7225} \\ 3750 \\ \underline{2890} \\ 8600 \\ \underline{7225} \end{array}$$

122 A KEY TO THE STANDARD ARITHMETIC

39. $.08 \cdot 10 \mid .17606$

$$\begin{array}{r} 1 \\ 27 \overline{) 210} \\ \underline{189} \\ 346 \overline{) 2100} \\ \underline{2076} \\ 2400 \\ \underline{2076} \end{array}$$

41. $12.68 \cdot 75 \mid 8.56195$

$$\begin{array}{r} 9 \\ 65 \overline{) 368} \\ \underline{325} \\ 706 \overline{) 4375} \\ \underline{4286} \\ 7121 \overline{) 13900} \\ \underline{7121} \\ 67790 \\ \underline{64089} \\ 37010 \\ \underline{35805} \end{array}$$

43. $.00 \cdot 46 \cdot 66 \cdot 66$, etc. $\mid .06831$

$$\begin{array}{r} 36 \\ 128 \overline{) 1066} \\ \underline{1024} \\ 1363 \overline{) 4286} \\ \underline{4089} \\ 1776 \\ \underline{1363} \end{array}$$

40. $42.90 \mid 6.54980$

$$\begin{array}{r} 36 \\ 125 \overline{) 690} \\ \underline{625} \\ 1304 \overline{) 6500} \\ \underline{5216} \\ 18089 \overline{) 128400} \\ \underline{117801} \\ 105990 \\ \underline{104712} \\ 12780 \end{array}$$

42. $25.07 \cdot 50 \mid 5.00749$

$$\begin{array}{r} 25 \\ 10007 \overline{) 075000} \\ \underline{70049} \\ 49510 \\ \underline{40028} \\ 94810 \\ \underline{90063} \end{array}$$

44. $.00 \cdot 04 \cdot 44 \cdot 44$, etc. $\mid .02108$

$$\begin{array}{r} 4 \\ 41 \overline{) 44} \\ \underline{41} \\ 344 \\ \underline{328} \end{array}$$

APPLICATIONS OF SQUARE ROOT.

Page 332.

1. $45 \text{ A. } 25 \text{ sq. rd.} = 7225 \text{ sq. rd.};$

$\sqrt{7225 \text{ sq. rd.}} = 85 \text{ rd.}$, the length or breadth of farm.

2. Since the length is twice the breadth, if it is divided into two equal fields, each containing 40 acres, each will be a square whose side is half the length of the rectangle.

$160 \text{ sq. rd.} \times 40 = 6400 \text{ sq. rd.}$, the area of each square;

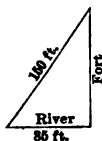
$\sqrt{6400 \text{ sq. rd.}} = 80 \text{ rd.}$, the side of square, and breadth of rectangle.

Since the length is twice the breadth, the length will be $80 \text{ rd.} \times 2 = 160 \text{ rd.}$

3. 8000 men - 256 men = 7744 men ; $\sqrt{7744} = 88$, men in rank.
4. Since the garden is 324 yd. square, it will contain 104,976 sq. yd.
 9 times 104,976 sq. yd. = 944,784 sq. yd. ;
 $\sqrt{944,784} = 972$, the number of yards square.
5. $2(135 + 60) = 390$ rd., distance around rectangular field ;
 $\$1.85 \times 390 = \726.50 , cost of fencing rectangular field ;
 $135 \times 60 = 8100$ sq. rd., area of field ;
 $\sqrt{8100} = 90$ rd., one side of square field ;
 $90 \text{ rd.} \times 4 = 360$ rd., distance around square field ;
 $\$1.85 \times 360 = \666.00 , cost of fencing square field ;
 $\$726.50 - \$666.00 = \$60.50$, amount more to fence rectangular field.

Page 333.

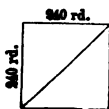
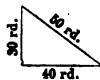
7. $\sqrt{24^2 - 12^2} = 20.78 + \text{ft.}$;
 $20.78 + \text{ft.} \times 2 = 41.56 + \text{ft.}$, width of house.



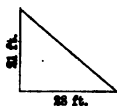
8. The distance from the top of the fort to the opposite side of the river, 150 ft., is the hypotenuse of a right-angled triangle which has for its base the distance across the river, which is 85 ft. ; therefore we must find the perpendicular side of the triangle, which will be the height of the fort.

$$\sqrt{150^2 - 85^2} = 123.59 + \text{ft.}, \text{ the height of fort.}$$

9. $\sqrt{40^2 + 30^2} = 50$ rd., the hypotenuse of field ;
 $50 \text{ rd.} + 40 \text{ rd.} + 30 \text{ rd.} = 120$ rd., the distance around field ;
 $\$1.75 \times 120 = \210.00 , the cost of fencing.



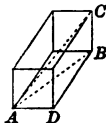
10. $160 \text{ sq. rd.} \times 360 = 57,600 \text{ sq. rd.}$, area of field ;
 $\sqrt{57,600} = 240$ rd., one side of field ;
 $\sqrt{240^2 + 240^2} = 339.41$, the hypotenuse, or distance from one corner to the opposite corner.



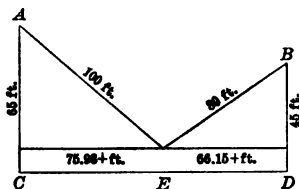
11. $\sqrt{28^2 + 21^2} = 35$ ft., the hypotenuse of the triangle, or the length of broken portion;
 35 ft. + 21 ft. = 56 ft., the height of the tree.

12. The angle ADB is a right angle (in perspective); therefore $\sqrt{24^2 + 18^2} = 30$, the distance AB , or distance diagonally across floor.

The angle ABC is a right angle (in perspective);



therefore $\sqrt{30^2 + 12^2} = 32.31+$, the distance AC .



13. $\sqrt{100^2 - 65^2} = 75.98+$ ft., the distance CE ;
 $\sqrt{80^2 - 45^2} = 66.15$ ft., the distance ED .

75.98 ft. + 66.15 ft. = 142.13 ft., the distance between the columns.

SIMILAR SURFACES.

Page 334.

2. $8 \text{ ft.} : ? :: \sqrt{1} : \sqrt{4}$; $\frac{8 \text{ ft.} \times \sqrt{4}}{\sqrt{1}} = 16 \text{ ft.}$, the diameter of larger bed.

3. $80 \times 60 = 4800$, the number of square rods;
 $4800 \text{ sq. rd.} \div 160 \text{ sq. rd.} = 30$, the number of acres, the area of the larger field.

$80 \text{ rd.} : ? :: \sqrt{30} : \sqrt{13\frac{1}{2}}$; $\frac{80 \text{ rd.} \times \sqrt{13\frac{1}{2}}}{\sqrt{30}} = 53.66 \text{ rd.}$, the length;

$60 \text{ rd.} : ? :: \sqrt{30} : \sqrt{13\frac{1}{2}}$; $\frac{60 \text{ rd.} \times \sqrt{13\frac{1}{2}}}{\sqrt{30}} = 40.24 \text{ rd.}$, the width.

4. $7.18 \text{ rd.} : ? :: \sqrt{1} : \sqrt{6\frac{1}{2}}$; $\frac{7.18 \text{ rd.} \times \sqrt{6\frac{1}{2}}}{\sqrt{1}} = 18.178 \text{ rd.}$, the length.

5. Since the diameter of the larger pipe is 4 times the diameter of the smaller one, it will discharge 16 times as much water per minute, or 16 times 6 gal., which is 96 gal. In 5 minutes, it will discharge 5 times 96 gal., or 480 gal.

6. First blackboard : second blackboard :: $3^2 : 6^2$; or
 first : second :: $9 : 36$; or the larger is 4 times the smaller.

CUBE ROOT.

Page 340.

5. $54\text{-}872\text{ | }38$

$$\begin{array}{r|l} 27 & \\ \hline 2700 & 27872 \\ 720 & \\ 64 & \\ \hline 3484 & 27872 \end{array}$$

6. $175\text{-}616\text{ | }56$

$$\begin{array}{r|l} 125 & \\ \hline 7500 & 60616 \\ 900 & \\ 36 & \\ \hline 8436 & 60616 \end{array}$$

7. $405\text{-}224\text{ | }74$

$$\begin{array}{r|l} 343 & \\ \hline 14700 & 62224 \\ 840 & \\ 18 & \\ \hline 15556 & 62224 \end{array}$$

8. $857\text{-}375\text{ | }95$

$$\begin{array}{r|l} 729 & \\ \hline 24300 & 128375 \\ 1350 & \\ 25 & \\ \hline 25675 & 128375 \end{array}$$

9. $3\text{-}048\text{-}625\text{ | }145$

$$\begin{array}{r|l} 1 & \\ \hline 300 & 2048 \\ 120 & \\ 18 & \\ \hline 486 & 1744 \\ & 304625 \\ 58800 & \\ 2100 & \\ 25 & \\ \hline 60925 & 304625 \end{array}$$

10. $43\text{-}614\text{-}208\text{ | }352$

$$\begin{array}{r|l} 27 & \\ \hline 2700 & 16614 \\ 450 & \\ 25 & \\ \hline 3175 & 15875 \\ & 739208 \\ 367500 & \\ 2100 & \\ 4 & \\ \hline 369604 & 739208 \end{array}$$

11. $180\text{-}323\text{-}843\text{ | }507$

$$\begin{array}{r|l} 125 & \\ \hline 7500 & 5323 \\ & 0000 \\ & 5323843 \\ 750000 & \\ 10500 & \\ 49 & \\ \hline 760549 & 5323843 \end{array}$$

12. $1\text{-}865\text{-}409\text{-}391\text{ | }1231$

$$\begin{array}{r|l} 1 & \\ \hline 300 & 865 \\ 60 & \\ 4 & \\ \hline 364 & 728 \\ & 187409 \\ 43200 & \\ 1080 & \\ 9 & \\ \hline 44289 & 182867 \\ & 4542391 \\ 4538700 & \\ 3690 & \\ 1 & \\ \hline 4542391 & 4542391 \end{array}$$

126 A KEY TO THE STANDARD ARITHMETIC.

13. 4-065-356-736 | 1596

	1	
300	3065	
150		
25		
475	2375	
	690356	
67500		
4050		
81		
71631	644679	
	45677736	
7584300		
28620		
38		
7612956	45677736	

15. 491-916-472-984 | 7894

	348	
14700	148916	
1680		
64		
16444	131552	
	17364472	
1825200		
21060		
81		
1846341	16617069	
	747403984	
186756300		
94680		
16		
186850996	747403984	

14. 95-256-152-263 | 4567

	64	
4800	31256	
600		
25		
5425	27125	
	4131152	
607500		
8100		
38		
615636	3693816	
	437336263	
62380800		
95760		
49		
62476609	437336263	

16. 13-312.053 | 23.7

	8	
1200	5812	
180		
9		
1389	4167	
189		
158700	1145053	
4830		
49		
163579	1145053	

18. .000-166-375 | .055

	125	
7500	41375	
750		
25		
8275	41375	

17. 28.094-464 | 3.04

	27	
2700	1094	
000		
0		
2700	0000	
000		
270000	1094464	
3600		
16		
273616	1094464	

19. .000-001-958-125 | .0125

$$\begin{array}{r}
 1 \\
 300 \overline{) 958} \\
 \underline{60} \\
 364 \overline{) 728} \\
 \underline{64} \\
 43200 \\
 \underline{1800} \\
 25 \\
 \underline{45025} \quad 225125
 \end{array}$$

20. 2.000-000-000, etc. | 1.2599

$$\begin{array}{r}
 1 \\
 300 \overline{) 1000} \\
 \underline{60} \\
 364 \overline{) 728} \\
 \underline{64} \\
 43200 \\
 \underline{1800} \\
 25 \\
 \underline{45025} \quad 225125 \\
 1825 \overline{) 46875000} \\
 \underline{4687500} \\
 33750 \\
 \underline{81} \\
 4721331 \quad 42491979 \\
 \underline{43830210} \\
 42491979
 \end{array}$$

21. 6.000-000-000, etc. | 1.81712

$$\begin{array}{r}
 1 \\
 300 \overline{) 5000} \\
 \underline{240} \\
 64 \overline{) 4832} \\
 \underline{304} \\
 97200 \\
 \underline{540} \\
 1 \\
 \underline{97741} \quad 97741 \\
 541 \overline{) 70259000} \\
 \underline{9828300} \\
 38010 \\
 \underline{49} \\
 9866359 \quad 69064513 \\
 11944870 \\
 \underline{9866359} \\
 20785110 \\
 \underline{19932718}
 \end{array}$$

22. $\frac{1}{3} = 44444$, etc.

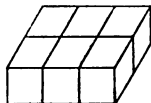
$$\begin{array}{r}
 .444-444-444, \text{ etc.} \quad | \quad .7631 \\
 343 \\
 14700 \overline{) 101444} \\
 \underline{1260} \\
 36 \overline{) 95976} \\
 \underline{15996} \\
 456 \overline{) 5468444} \\
 \underline{1648800} \\
 68670 \\
 \underline{9} \\
 1777479 \quad 5158437 \\
 \underline{3150074} \\
 1717479 \\
 \sqrt[3]{5832} = 18; \\
 \sqrt[3]{10648} = 27; \\
 \therefore \sqrt[3]{\frac{5832}{10648}} = \frac{18}{27} \\
 \sqrt[3]{157464} = 54; \\
 \sqrt[3]{34965788} = 327; \\
 \therefore \sqrt[3]{\frac{34965788}{157464}} = \frac{327}{54}
 \end{array}$$

APPLICATIONS OF CUBE ROOT.

Page 341.

1. $\sqrt[3]{64,872 \text{ cu. in.}} = 38 \text{ in.}$, the length of edge.
2. $\sqrt[3]{2744 \text{ cu. ft.}} = 14 \text{ ft.}$, the depth of cistern.
3. $\sqrt[3]{185,193 \text{ cu. in.}} = 57 \text{ in.}$, the edge of cube ;
 $57 \times 57 = 3249$, the square inches in the area of one face.
4. $5\frac{1}{2} \times 4\frac{1}{2} \times 2\frac{3}{4} = 64 \text{ cu. ft.}$;
 $\sqrt[3]{64} = 4$, the number of feet in the length of side.
5. $2150.42 \text{ cu. in.} \times 1200 = 2,580,504 \text{ cu. in.}$;
 $2,580,504 \text{ cu. in.} \div 1728 = 1493.347222 + \text{ cu. ft.}$;
 $\sqrt[3]{1493.347222} = 11.43$, the feet in depth, or 11 ft. 5.16 in.
6. $400 \text{ bbl.} = 12,600 \text{ gal.}$; $231 \text{ cu. in.} \times 12,600 = 2,910,600 \text{ cu. in.}$;
 $\sqrt[3]{2,910,600} = 142.77$, the inches in depth, or 11 ft. 10.77 in. deep.
7. The dimensions of the cistern are each 142.77 in., or 11.8975 ft. ;
 $11.8975 \times 11.8975 = 141.55 \text{ sq. ft.}$, the area of each side ;
 $141.55 \text{ sq. ft.} \times 5 = 707.75 \text{ sq. ft.}$, the surface plastered ;
 $707.75 \text{ sq. ft.} \div 9 = 78.64 \text{ sq. yd.}$;
 $\$.35 \times 78.64 = \27.52 , the expense.
8. Since the bin is twice as long as it is wide, or high, it is equal to two cubical bins each containing 250 bu. of grain.
 $2150.42 \text{ cu. in.} \times 250 = 537,605 \text{ cu. in.}$;
 $537,605 \div 1728 = 311.114 +$, the number of cubic feet ;
 $\sqrt[3]{311.114} = 6.776 +$, the number of feet in width, or depth, of bin ;
 $6.776 \text{ ft.} \times 2 = 13.55$, the number of feet in the length of bin.
9. $\sqrt[3]{4096} = 16 \text{ ft.}$, one edge of the cube ;
 $16 \times 16 = 256 \text{ sq. ft.}$, the area of one face ;
 $256 \text{ sq. ft.} \times 6 = 1536 \text{ sq. ft.}$, the entire surface of the cube.

Since the width of the rectangular solid is twice its height, and the length three times its height, if it is divided into two equal parts lengthwise, and each half into three equal parts, there will be six cubes, the dimensions of which will be the height of the rectangular solid.



- $4096 \text{ cu. ft.} \div 6 = 682.66 \text{ cu. ft.}$, the volume of each small cube ;
 $\sqrt[3]{682.66} \text{ cu. ft.} = 8.805 \text{ ft.}$, the height of the rectangular solid ;
 $8.805 \text{ ft.} \times 2 = 17.61 \text{ ft.}$, the width of the rectangular solid ;
 $8.805 \text{ ft.} \times 3 = 26.415 \text{ ft.}$, the length of the rectangular solid ;
 $8.805 \times 17.61 = 155.056 \text{ sq. ft.}$, the area of one end ;
 $155.056 \text{ sq. ft.} \times 2 = 310.112 \text{ sq. ft.}$, the area of the ends ;
 $8.805 \times 26.415 = 232.584 \text{ sq. ft.}$, the area of one side ;
 $232.584 \text{ sq. ft.} \times 2 = 465.168 \text{ sq. ft.}$, the area of the sides ;
 $26.415 \times 17.61 \times 2 = 930.336 \text{ sq. ft.}$, the area of top and bottom ;
 $310.112 \text{ sq. ft.} + 465.168 \text{ sq. ft.} + 930.336 \text{ sq. ft.} = 1705.616 \text{ sq. ft.}$,
 the total area of the rectangular solid ;
 $1705.616 \text{ sq. ft.} - 1536 \text{ sq. ft.} = 169.616 \text{ sq. ft.}$ more in the surface
 of the rectangular solid than in the surface of the cube.

SIMILAR VOLUMES.

Page 342.

2. Small cube : large cube :: $4^3 : 16^3$; or
 small cube : large cube :: $1 : 64$; that is, the large cube con-
 tains 64 times as much as the small one.
3. $3^3 : 5^3 :: 7 \text{ lb.} : ?$; $\frac{7 \text{ lb.} \times 125}{27} = 32\frac{1}{3} \text{ lb.}$
4. $5^3 : 10^3 :: 100.44 \text{ bu.} : ?$; $\frac{100.44 \text{ bu.} \times 1000}{125} = 803.52 \text{ bu.}$
5. $\sqrt[3]{1} : \sqrt[3]{4} :: 1\frac{1}{2} \text{ ft.} : ?$; $\frac{1\frac{1}{2} \text{ ft.} \times \sqrt[3]{4}}{\sqrt[3]{1}} = 2.38 \text{ ft.}$
6. $\sqrt[3]{120} : \sqrt[3]{6400} :: 1 \text{ in.} : ?$; $\frac{1 \text{ in.} \times \sqrt[3]{6400}}{\sqrt[3]{120}} = 3.76 \text{ in.}$

$$7. (5\frac{1}{2})^3 : 6^3 :: 140 \text{ lb.} : ?; \frac{140 \text{ lb.} \times 216}{166.375} = 181\frac{999}{11} \text{ lb.}$$

8. Smaller ball : larger ball :: $4^3 : 5^3$, or $64 : 125$; that is, the larger ball is 1.95 times the smaller ball. Therefore a ball whose contents are equal to them both will be 2.95 times the smaller ball. Hence,

$$\sqrt[3]{1} : \sqrt[3]{2.95} :: 4 \text{ in.} : ?; 4 \text{ in.} \times \sqrt[3]{2.95} = 5.73 \text{ in.}$$

$$9. \sqrt[3]{17} : \sqrt[3]{136} :: 13 \text{ ft.} : ?; \frac{13 \text{ ft.} \times \sqrt[3]{136}}{\sqrt[3]{17}} = 26 \text{ ft.}$$

10. Since the measures are to be of similar form,

$$\sqrt[3]{1} : \sqrt[3]{\frac{1}{4}} :: 8 : ?;$$

$$\frac{\sqrt[3]{\frac{1}{4}} \times 8}{1} = 5.039, \text{ the inches in depth};$$

$$\sqrt[3]{1} : \sqrt[3]{\frac{1}{4}} :: 18\frac{1}{2} : ?;$$

$$\frac{\sqrt[3]{\frac{1}{4}} \times 18\frac{1}{2}}{1} = 11.654, \text{ the inches in diameter.}$$

GENERAL REVIEW EXERCISES — ORAL.

Page 343.

1. Since one boy has twice as much as the other, both must have three times as much as that other has. Hence 3 times what the other has is 45¢, and his money is 15¢. $45¢ - 15¢ = 30¢$, the share of the boy who has twice as much as the other.

2. If a man can do $\frac{1}{3}$ of a piece of work in a day, he can do $\frac{1}{3}$ of it in $\frac{1}{3}$ of a day, and the whole work in 5 times $\frac{1}{3}$ of a day, or $\frac{5}{3}$ of a day. Since he can do the whole work in $\frac{5}{3}$ of a day, he can do $\frac{1}{2}$ of it in $\frac{1}{2}$ of $\frac{5}{3}$ of a day, or $\frac{5}{6}$ of a day.

3. If 5 men can do a piece of work in 12 days, it will require 5 times 12 days, or 60 days, for 1 man to do it, and 8 men can do it in $\frac{1}{8}$ of 60 days, or $7\frac{1}{2}$ days.

4. If he had paid \$2 a head more, he must have purchased as many sheep to make up \$16 as \$2 is contained times in \$16, or 8 sheep.

5. Since 50 men can do the work in 8 days, it will require 1 man 50 times 8 days, or 400 days to do it, and 40 men can do it in $\frac{1}{40}$ of 400 days, or 10 days.

6. Since A can do the work in 3 days, he can do $\frac{1}{3}$ of it per day, and since B can do it in $4\frac{1}{2}$ days, he can do $\frac{1}{4\frac{1}{2}}$, or $\frac{2}{9}$, of it per day. Both together can do $\frac{1}{3} + \frac{2}{9}$, or $\frac{5}{9}$, of it per day, hence they can do $\frac{1}{3}$ of it in $\frac{1}{5}$ of a day, and the whole in 9 times $\frac{1}{5}$ of a day, or $\frac{9}{5}$ of a day, or $1\frac{4}{5}$ days.

7. Both together can hoe $\frac{1}{3}$ of the field per day. James can hoe $\frac{1}{4}$ of it per day. Therefore Henry can hoe $\frac{1}{3} - \frac{1}{4}$, or $\frac{1}{12}$ of the field per day. Since he can hoe $\frac{1}{12}$ of the field per day, he can hoe $\frac{1}{12}$ of it in $\frac{1}{12}$ of a day, and the whole field in 12 of a day, or 12 days.

8. Since A can make a door in $\frac{3}{4}$ of a day, he can do half the work in $\frac{1}{2}$ of a day, and hence can make $\frac{1}{2}$ of a door per day. Since B can make a door in $\frac{3}{4}$ of a day, he can make $\frac{1}{3}$ of a door per day, and both together can make $\frac{1}{2} + \frac{1}{3}$, or $\frac{5}{6}$, of a door, or $2\frac{2}{3}$ doors per day.

9. Since B can make $\frac{1}{3}$ of a door in a day, in $\frac{1}{2}$ of day he can make $\frac{1}{6}$ of it, hence there is but $\frac{1}{6}$ of the door to make after B has worked $\frac{1}{2}$ of a day. Since A can make a door in $\frac{3}{4}$ of a day, he can make $\frac{1}{3}$ of it in $\frac{1}{3}$ of $\frac{3}{4}$, or $\frac{1}{4}$, of a day.

10. Since all working together can do $\frac{1}{10}$ of the work in 1 day, and A can do $\frac{1}{12}$ of it and B $\frac{1}{15}$ of it in 1 day, C can do the difference between $\frac{1}{10}$ and the sum of $\frac{1}{12}$ and $\frac{1}{15}$ of the work in 1 day, which is $\frac{1}{60}$, or $\frac{1}{60}$, of the work. Since he can do $\frac{1}{60}$ of it per day, he can do the whole in 60 days.

11. If I lose $\frac{2}{3}$ of my money, I have but $\frac{1}{3}$ of it left. If I spend $\frac{1}{4}$ of the remainder I can have only $\frac{2}{12}$ of the remainder left. Therefore I will have left $\frac{2}{12}$ of $\frac{1}{3}$, or $\frac{1}{18}$, of my money.

Page 344.

12. Since all can do $\frac{1}{3}$ of the work per day, and Peter and Jacob can do $\frac{1}{3}$ of it per day, George can do $\frac{1}{3} - \frac{1}{6}$, or $\frac{1}{6}$, of the work per day. He can, therefore, do $\frac{1}{6}$ of the work in $\frac{1}{6}$ of a day, and the whole work in 6 , or 6 days. Since Peter and Jacob can do $\frac{1}{3}$ of the work per day, and Peter alone can do $\frac{1}{6}$ of it in 1 day, Jacob can do $\frac{1}{3} - \frac{1}{6}$, or $\frac{1}{6}$, of the work per day. He can, therefore, do the whole work in 6 days.

Hence Peter can do the work in 6 days, George in 6 days, and Jacob in 6 days.

13. Since I gain $\frac{1}{2}$ of a cent apiece on the eggs, I gain 4¢ per dozen. They cost me, therefore, 4¢ per dozen. By selling them at 10¢ per dozen I shall gain 6¢ per dozen, or $\frac{1}{2}$ ¢, apiece.

14. Since a difference of 3¢ per dozen in the price of eggs makes a difference of 27¢ in the money received, I must have had 9 dozen eggs. Since I would lose 15¢ by selling them at 6¢ per dozen, they must have cost 15¢ more than 9 times 6¢, or the cost was 69¢.

15. Since $\frac{3}{4}$ of A's money = $\frac{2}{3}$ of B's money,
 $\frac{1}{4}$ of A's money = $\frac{2}{3}$ of B's money;
 $\frac{1}{2}$ of A's money = $\frac{4}{3}$ of B's money;
 $\frac{1}{7}$ of A's money = $\frac{4}{3}$ of $\frac{3}{7}$ of B's money, or B's money.

16. Since $\frac{1}{7}$ of the number lacks 14 of being equal to the number,
the other $\frac{6}{7}$ of the number must be equal to 14.
Since $\frac{1}{7}$ of the number = 14; $\frac{1}{7}$ of the number = 2;
the number = 17 times 2, or 34.

17. Since \$6 = $\frac{2}{3}$ of what the bureau cost him,
\$2 = $\frac{1}{3}$ of what it cost him; and it cost him 5 times \$2, or \$10.
Since \$10 = $\frac{2}{3}$ of what it cost me, \$2 = $\frac{1}{3}$ of what it cost me;
and it cost me 4 times \$2, or \$8.

18. \$24 - \$14 = \$10, the sum lost in wages and board;
\$24 ÷ 16 = \$1 $\frac{1}{2}$, the daily wages;
\$1.50 + \$1.00 = \$2.50, the daily loss when idle;
\$10 ÷ \$2.50 = 4, the number of days idle.
Therefore he worked 12 days.

19. \$40 - \$29 $\frac{1}{2}$ = \$10 $\frac{1}{2}$, the sum lost by being idle. Since he lost his wages of \$2 per day, and forfeited \$1 $\frac{1}{2}$ per day for every idle day, it would take as many days to lose \$10 $\frac{1}{2}$ as \$3 $\frac{1}{2}$ is contained times in \$10 $\frac{1}{2}$, which is 3. Therefore he was idle 3 days.

20. Since they were to share in the ratio of $\frac{1}{2}$ to $\frac{1}{3}$, that was the same as the ratio of $\frac{3}{2}$ to $\frac{2}{3}$, or 3 to 2. Hence out of every \$5 paid out one received \$3 and the other \$2, or one received $\frac{3}{5}$ of the sum, and the other $\frac{2}{5}$ of it.

$\frac{3}{5}$ of \$150 = \$90, the share of first;

$\frac{2}{5}$ of \$150 = \$60, the share of second.

21. Since B received $\frac{1}{3}$ of the gain, A received the remainder, or $\frac{2}{3}$ of the gain, and must have invested $\frac{2}{3}$ of the capital. Therefore $\frac{2}{3}$ of the capital = \$36; $\frac{1}{3}$ of the capital = \$12; the capital = \$96. \$96 - \$36 = \$60, B's investment.

22. To share in the ratio of $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$ is the same as in the ratio of $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, or 20, 15, and 12. Therefore out of every \$47 one received \$20, another \$15, and another \$12, or one received $\frac{4}{7}$, another $\frac{3}{7}$, and another $\frac{2}{7}$ of the sum of money. The difference between the second and third shares = $\frac{1}{7}$ of money. Therefore $\frac{3}{7}$ of the money was \$9, $\frac{1}{7}$ of it \$3; the share of the first, $\frac{4}{7}$ of it, or \$60; the share of the second, $\frac{3}{7}$ of it, or \$45; the share of the third, $\frac{2}{7}$ of it, or \$36.

23. If a man can earn $\frac{1}{3}$ in $\frac{1}{2}$ of a day, he can earn $\frac{1}{2}$ of $\frac{1}{3}$, or $\frac{1}{6}$, in $\frac{1}{4}$ of a day, and 4 times $\frac{1}{6}$, or $\frac{2}{3}$, in a day. In $\frac{1}{3}$ of a day he can earn $\frac{1}{3}$ of $\frac{2}{3}$, or $\frac{2}{9}$.

Page 345.

24. Since $\frac{3}{4}$ of the cost of the carriage = $\frac{1}{2}$ of the cost of the horse,
 $\frac{1}{4}$ of the cost of the carriage = $\frac{1}{8}$ of the cost of the horse;
 the cost of the carriage = $\frac{2}{3}$ of the cost of the horse.

Therefore the difference between the cost of the carriage and the cost of the horse was equal to $\frac{1}{8}$ of the cost of the horse.

$\frac{1}{8}$ of the cost of the horse = \$20; the cost of the horse = \$160;
 $\frac{2}{3}$ of \$160 = \$180, the cost of the carriage.

25. Since he can saw 1 cd. in $\frac{1}{2}$ of a day, and split 1 cd. in $\frac{1}{3}$ of a day, it will take him $\frac{1}{2} + \frac{1}{3}$, or $\frac{5}{6}$, of a day to saw and split 1 cd., and he can saw and split as many cords in 1 day as $\frac{6}{5}$ is contained times in 1, which is $1\frac{1}{5}$ times. Therefore he can saw and split $1\frac{1}{5}$ cd. in 1 day.

27. \$1.00 + \$.50 = \$1.50, half of his money before he bought the shoes. Therefore \$3.00 was the amount of his money before he bought the shoes. \$3.00 + \$.50 = \$3.50, half of his money before he bought the hat. Therefore \$7.00 was the money he had before he bought the hat. \$7.00 + \$.50 = \$7.50, half of his money before buying the coat. Therefore \$15.00 was money he had at first.

28. $\frac{1}{3}$ of whole + 15 gal. = amount sold;
 $\frac{2}{3}$ of whole - 15 gal. = amount left.

Since he had left 4 times as much as he had sold, or $\frac{4}{3}$ of the whole + 60 gal., $\frac{2}{3}$ of the whole - 15 gal. = $\frac{4}{3}$ of the whole + 60 gal.

Since $\frac{2}{3}$ of the whole quantity *when diminished* by 15 gal. was equal to $\frac{1}{3}$ of the whole + 60 gal., $\frac{2}{3}$ of the whole must have been 15 gal. more than $\frac{1}{3}$ of the quantity + 60 gal., or $\frac{1}{3}$ of the quantity + 75 gal. Therefore $\frac{2}{3}$ of the whole quantity = $\frac{1}{3}$ of the whole quantity + 75 gal. Since 75 gal. when added to $\frac{1}{3}$ of the quantity makes just $\frac{2}{3}$ of the quantity, the 75 gal. must be equal to $\frac{1}{3}$ of the quantity, and the whole quantity was 7 times $\frac{1}{3}$ of 75 gal., or $262\frac{1}{2}$ gal.

29. Since James earned $\frac{1}{2}$ as much as John, James and John earned $1\frac{1}{2}$ times as much as John. Since Henry earned $\frac{1}{4}$ as much as James and John, he earned $\frac{1}{4}$ of $1\frac{1}{2}$ times as much as John, or $\frac{3}{8}$ as much as John. Since James and John earned $\frac{3}{2}$ as much as John, and Henry $\frac{3}{8}$ as much, all together earned $1\frac{3}{8}$ as much as John. Therefore $\frac{1}{4}$ of what John earned = 150ϕ ; $\frac{1}{8}$ of what he earned = 10ϕ ; the whole sum earned by John = 80ϕ ; James earned $\frac{1}{2}$ of 80ϕ , or 40ϕ , and Henry $\frac{1}{4}$ of ($80\phi + 40\phi$), or 30ϕ .

30. Since $\frac{2}{3}$ of the part broken off = $\frac{1}{3}$ of the part standing,
 $\frac{1}{3}$ of the part broken off = $\frac{5}{18}$ of the part standing;
 the whole part broken off = 5 times $\frac{5}{18}$, or $\frac{25}{18}$, of the part standing;
 $\frac{1}{3}$ of the part standing + the part standing, or $\frac{4}{3}$ of the part standing = 129 ft. ;
 $\frac{1}{18}$ of the part standing = 3 ft. ;
 the part standing = 18 times 3 ft., or 54 ft. ;
 $\frac{1}{3}$ of 54 ft. = 18 ft., the part broken off.

31. Since the wheat pays a profit of $\frac{1}{2}$ the cost, the selling price must have been $\frac{3}{2}$ of the cost. Since $\frac{2}{3}$ of the cost was \$1.50, the cost was \$1.00. Since the cost was \$1, and the selling price is \$2, the gain will be *equal* to the cost.

32. If he sells $\frac{2}{3}$, or $\frac{4}{6}$, of an article for what $\frac{1}{3}$ of it cost, he gains $\frac{1}{3}$ on every $\frac{4}{6}$ of the cost, or $\frac{1}{6}$, or $16\frac{2}{3}\%$, of the cost.

33. $100\% - 40\% = 60\%$; 10% of $60\% = 6\%$, discount for cash ;
 $40\% + 6\% = 46\%$, the total discount.

34. $100\% - 80\% = 20\%$; 20% of $20\% = 4\%$, discount for cash ;
 $80\% + 4\% = 84\%$, the total discount.

Page 346.

35. $100\% - 25\% = 75\%$; $75\% - 10\%$ of $75\% = 67\frac{1}{2}\%$ the cost;
 $100\% - 10\% = 90\%$; $90\% - 25\%$ of $90\% = 67\frac{1}{2}\%$ the cost.

Therefore the difference is nothing.

36. $50¢ - 20\%$ of $50¢ = 40¢$; $40¢ - 5\%$ of $40¢ = 38¢$, the price per yard for which he offered them.

37. The interest on \$1 at 6% for 3 yr. 6 mo. = \$.21; therefore it will take as many dollars to earn \$42 interest as \$.21 is contained times in \$42; $\$42 \div \$.21 = 200$. Therefore he must have given his note for \$200.

38. Since he wishes to secure an income of \$800 from 4% bonds, \$800 must be 4% of the par value of the bonds; $\$800 \div .04 = \$20,000$, the par value, or face value, of the bonds. He can buy as many thousand-dollar bonds as \$1000 is contained times in \$20,000, which is 20. Therefore he must purchase 20 thousand-dollar bonds.

41. Since $\frac{1}{100}$ of the cost = \$400, $\frac{1}{1000}$ of the cost = \$50;
 the cost = 100 times \$50, or \$5000.

42. Since A had 320 acres after his purchase from B, he must have purchased 80 acres from B, leaving B with but 160 acres; therefore B has half as many acres as A, or 50% as much land as A.

43. 20% of \$1.00 = \$.20; $\$1.00 - \$.20 = \$.80$, the cost of the books per volume. Therefore I gained 20¢ on an investment of 80¢, or $\frac{1}{4}$ of the cost, or 25%.

44. Since the goods are sold so that $\frac{1}{2}$ of the cost is received for half of the quantity, at that rate $\frac{1}{7}$ of the cost would be received for the whole quantity; the gain would then be $\frac{1}{7}$ of the cost, or 42% of the cost.

45. Since I asked 20% more for the goods than they cost, my asking price was 120% of the cost, and since I sold them at 10% less than I asked for them, I received but 90% of the asking price, or 90% of 120% of the cost, or 108% of the cost; since I received 108% of the cost for them, my gain was 8%.

Page 347.

46. Since 125% of what B paid for the horse = \$150,
 1% of what B paid for the horse = \$1.20;
 the cost of the horse to B = \$120.
 Since 120% of what A paid for the horse = \$120,
 1% of what A paid for the horse = \$1;
 the cost of the horse to A = \$100.

47. Since the exchange is \$12.50 on \$5000 the rate is $\frac{1}{4}\%$.

48. Since every foot in the length of the shadow represents $2\frac{1}{2}$ feet in the length of the object which casts it, the steeple which casts a shadow of 30 feet must be 30 times $2\frac{1}{2}$ ft., or 75 ft. high.

49. Since 6 times a number = $4\frac{1}{2}$ times the number + 33, 33 must be the equal to the difference between 6 times the number and $4\frac{1}{2}$ times the number, or $1\frac{1}{2}$ times the number. Therefore,

$$\frac{1}{2} \text{ of the number} = 33;$$

$$\frac{1}{3} \text{ of the number} = 3;$$

$$\text{the number} = 18.$$

50. Since 3 times the number of sheep + 5 sheep equals 185 sheep, 3 times the number of sheep must equal 180 sheep. Therefore he had 60 sheep.

51. At 2 o'clock the minute hand is 10 spaces behind the hour hand. Since the minute hand moves 60 spaces while the hour hand moves 5 spaces, the minute hand *gains* $\frac{1}{12}$ of a space every minute, and it will take it as many minutes to gain 10 spaces as $\frac{1}{12}$ is contained times in 10, which is $10\frac{10}{12}$. Therefore the hands will be together $10\frac{10}{12}$ minutes after 2 o'clock.

52. Since $\frac{2}{3}$ of the time past noon = $\frac{2}{3}$ of the time to midnight,
 $\frac{1}{3}$ of the time past noon = $\frac{1}{3}$ of the time to midnight;
 the time past noon = $\frac{1}{3}$ of the time to midnight.

Therefore the whole time from noon to midnight was $1\frac{1}{3}$ times the time to midnight. Consequently,

$$\frac{2}{3} \text{ of the time to midnight} = 12 \text{ hr.};$$

$$\frac{1}{3} \text{ of the time to midnight} = 1\frac{1}{3} \text{ hr.};$$

$$\text{the time to midnight} = 6\frac{2}{3} \text{ hr.}$$

Therefore the time past noon = 12 hr. - $6\frac{2}{3}$ hr., or $5\frac{1}{3}$ hr.;
 hence the time was 20 minutes past 5 o'clock.

53. Since the three eat 8 loaves of bread, each will eat $\frac{1}{3}$ of 8 loaves, or $2\frac{2}{3}$ loaves. A furnishes 3 loaves, therefore he contributes $\frac{1}{3}$ of a loaf towards C's portion. B contributes $2\frac{1}{3}$ loaves, or $\frac{7}{3}$, toward C's portion. Consequently, since A contributes $\frac{1}{3}$ and B $\frac{7}{3}$ of the bread which C eats, A should receive $\frac{1}{8}$ of 24¢, or 3¢, and B should receive $\frac{7}{8}$ of 24¢, or 21¢.

54. It will take $2\frac{2}{3}$ hr. to walk back the 8 miles he rides in an hour. Therefore it will take $3\frac{2}{3}$ hr. to go and return 8 miles; and since he can go and return 8 miles in $3\frac{2}{3}$ hr., he can go and return as many times 8 miles in 11 hr. as $3\frac{2}{3}$ is contained times in 11, which is 3. Therefore he can go and return 3 times 8 miles, or 24 miles, in 11 hr.

55. The current accelerates the speed of the yacht 4 miles an hour in sailing down, and retards its progress 4 miles an hour in sailing back. Then, since the yacht sails down stream 16 miles an hour and back 8 miles an hour, it will require 3 hr. of time for every 16 miles down and back, and it can go and return as many times 16 miles in 15 hr. as 3 is contained times in 15, which is 5. Therefore it can go 5 times 16 miles, or 80 miles in 15 hr.

57. Since 7 men can dig 32 rods in a day, it will require 3 times 7 men, or 21 men, to dig 96 rods in a day; but since the 96 rods must be dug in $\frac{3}{4}$ of a day, 21 men will be only $\frac{3}{4}$ of the number needed. 21 is $\frac{3}{4}$ of 28. Therefore 28 men will be required.

58. Since I have 6 cows, I might pasture 12 cows besides; or, since 18 cows require as much pasturage as 12 horses, 12 cows will require as much as 8 horses; therefore I can pasture 6 cows and 8 horses.

Page 348.

60. Since A is 25 years old, and B is 4 years old, A was 21 years old when B was born; when, therefore, his age is 4 times B's, it is equal to 21 yr. + B's age, consequently 21 years must be 3 times B's age, and B's age is 7 years when A is 4 times as old as he; and, since B is 4 years old now, A will be 4 times as old as B in 3 years.

61. Since 20 years is $\frac{5}{8}$ of his uncle's age, $\frac{1}{8}$ of his uncle's age is 4 years, and his uncle's age is 8 times 4 years, or 32 years; since his uncle was 32 years old when John was 20, his uncle was 12 years old at John's birth, and at 24 years of age was twice John's age; since John is now 20, and he was 12 when his uncle's age was twice his, that time was 8 years ago.

62. Since Mr. A is 35, and his son 10, Mr. A was 25 years old when his son was born, and will be 2 times 25, or 50, years of age when his son's age is half of his. Since he is 35 years old now, the son will be half the father's age in 50 yr. - 35 yr., or 15 years.

63. Since D's age ten years ago was 4 times C's age at that time, it is *now* 10 years more than 4 times C's age at that time.

Since C is 10 years older than he was ten years ago, we know also that D's age *now* is 3 times C's age ten years ago + 30 years. We have, therefore, two expressions for D's age now, and consequently, they must be equal; that is, 4 times C's age ten years ago + 10 years = 3 times C's age ten years ago + 30 years. Hence C's age ten years ago must have been 20 years, and D's 80 years, and C's age now is 30 years, and D's age 90 years.

64. Since the 10 additional sheep purchased at \$1 less per head increased the cost of the lot \$40, if they had been purchased at the same price as the others, they would have increased the cost \$50. Since 10 sheep at the price of the first lot increased the total cost \$50, the cost per head of the first lot must have been \$5, and since he paid \$100 for them, he must have purchased 20 sheep.

65. When 8 pay for the coach, each pays $\frac{1}{8}$ of the cost;
when 12 pay for the coach, each pays $\frac{1}{12}$ of the cost;

$$\frac{1}{8} - \frac{1}{12} = \frac{1}{24}; \frac{1}{24} \text{ of the cost} = \$1.$$

Therefore the price paid for the coach was \$24.

66. Since A can do $\frac{1}{3}$, or $\frac{2}{3}$, of the work in 1 day, and B $\frac{1}{2}$, or $\frac{1}{3}$, of the work, in 1 day, A does $\frac{2}{3}$ of the work, and B $\frac{1}{3}$ of the work. A, therefore, should receive $\frac{2}{3}$ of \$15, or \$9, and B should receive $\frac{1}{3}$ of \$15, or \$5.

67. Since C can do the work in $2\frac{1}{2}$ weeks, he can do $\frac{1}{2}$, or $\frac{2}{5}$, of it in a week; since D can do it in $2\frac{3}{4}$ weeks, he can do $\frac{2}{5}$, or $\frac{3}{7}$, of it in a week. Therefore C should receive $\frac{2}{5}$ of \$59, which is \$23.20, and D should receive $\frac{3}{7}$ of \$59, which is \$25.71.

68. Since A can earn \$30 in 15 days, he earns \$2 per day, and since he works 4 days, he earns \$8; since B finishes the work, he receives the remainder of the money, which is \$22.

69. Since 3 times the number of trees + 5 trees = 1358 trees,
3 times the number of trees = 1358 - 5, or 1353 trees;
the number of trees = 451 trees.

70. Since he received \$15 for $\frac{3}{4}$ of the remainder, he received \$7.50 for $\frac{1}{4}$ of the remainder, and \$22.50 for the remainder ;

$$\$36 - \$22.50 = \$13.50, \text{ the cost of the 9 pigs that died ;}$$

$$\$13.50 \div 9 = \$1.50, \text{ the cost of 1 pig ;}$$

$$\$36 \div \$1.50 = 24, \text{ the number of pigs bought.}$$

Page 349.

71. Since 1 of the hound's leaps is equal to 2 of the fox's leaps, 3 of the hound's leaps are equal to 6 of the fox's leaps ; therefore, since the fox takes 4 leaps while the hound takes 3 leaps, in taking 3 leaps the hound gains $6 - 4$, or 2 of the fox's leaps ; consequently to gain 60 of the fox's leaps the hound must take as many times 3 leaps as 2 leaps are contained times in 60 leaps, or 30 times 3 leaps, which is 90 leaps.

72. The hound gains 4 rods in every 30 rods ; therefore to gain 120 rods, he must run as many times 30 rods as 4 rods is contained times in 120 rods, which is 30 times. Therefore the hound must run 30 times 30 rods, or 900 rods.

73. Since 3 of the hound's leaps are equal to 7 of the hare's leaps, and the hound takes 3 leaps while the hare takes 5 leaps, in taking 3 leaps the hound gains $7 - 5$, or 2 of the hare's leaps ; consequently to gain 70 of the hare's leaps the hound must take as many times 3 leaps as 2 leaps are contained times in 70 leaps, or 35 times 3 leaps, which is 105 leaps.

74. Since by expending 20 cents for each pupil instead of 15 cents, the cost for each would have been increased 5 cents, and since the total cost would have been increased \$2 - \$1, or \$1, or 100 cents, there must have been as many pupils as 5 cents is contained times in 100 cents, or 20 pupils.

75. Since the cost of the cow was \$30, $\frac{2}{3}$ of the cost of the horse was equal to the cost of the sheep + \$30. Therefore,

$$\frac{2}{3} \text{ of the cost of the horse} = \text{the cost of the sheep} + \$30 ;$$

$$\text{and } \frac{1}{3} \text{ of the cost of the horse} = \frac{1}{3} \text{ of the cost of the sheep} + \$15 ;$$

$$\text{hence, the cost of the horse} = \frac{2}{3} \text{ of the cost of the sheep} + \$105.$$

Since the cost of the horse and sheep was \$150, and the cost of the horse was equal to $\frac{2}{3}$ of the cost of the sheep + \$105, $\frac{1}{3}$ of the cost of the sheep + \$105 was equal to \$150.

Therefore $\frac{3}{4}$ the cost of the sheep = \$45 ;
 $\frac{1}{4}$ the cost of the sheep = \$5 ;
 the cost of the sheep = \$10.

Hence the cow cost \$30, the sheep \$10, the horse \$140.

76. Since by paying 25 cents a yard for ribbon instead of 15 cents, the lady would have paid 10 cents more for each yard, and since by so doing the total difference in the cost of the quantity she bought would have been 50 cents plus 50 cents, or 100 cents, she bought as many yards as 10 cents is contained times in 100 cents, or 10 yards; therefore she had 10 times 15 cents plus 50 cents, or 150 cents plus 50 cents, or \$2.

77. Since the fish is composed of head, tail, and body, and the body is as long as the head and tail, the body is $\frac{2}{3}$ the length of the fish.

Since the tail is as long as the head and $\frac{1}{2}$ the body, the length of the tail is 8 in. + $\frac{1}{2}$ of the length of the fish, and head and tail together are in length 16 in. + $\frac{1}{4}$ of the length of the fish.

Since head and tail are $\frac{1}{2}$ of the length of the fish,

16 in. + $\frac{1}{4}$ of the length of the fish = $\frac{1}{2}$ of the length of the fish ;
 therefore $\frac{1}{4}$ of the length of the fish = 16 in. ; and
 the length of the fish = 64 in.

78. Since the middle part is twice as long as the other parts, it is $\frac{2}{3}$ of the length of the tree and the other parts are $\frac{1}{3}$ of its length. Since the part standing is 8 ft. long, and the top is 8 ft. long + $\frac{1}{2}$ of $\frac{2}{3}$, or $\frac{1}{3}$, of the length of the tree, the length of the top and the part standing are equal to $\frac{1}{3}$ of the length of the tree + 16 ft., or $\frac{2}{3}$ of the length of the tree. Therefore $\frac{1}{3}$ of the length of the tree was 16 ft. and its entire length 96 ft.

GENERAL REVIEW EXERCISES—WRITTEN.

Page 350.

1. The minuend 21,870 — the remainder 6492 = 15,378.
 2. $3217 \times 63 + 29 = 202,700$, the dividend.
 5. $\frac{21}{11\frac{1}{2}} = 21 \div 11\frac{1}{2} = \frac{36}{11}$; $\frac{5}{4}$ of $\frac{36}{11} = \frac{45}{11}$; $1\frac{4}{11} + \frac{45}{11} = \frac{59}{11}$;
- $$\frac{5}{2\frac{1}{2}} = \frac{5}{\frac{5}{2}} + 2\frac{1}{2} = \frac{2}{5} + \frac{5}{2} = \frac{25}{10} + \frac{25}{10} = \frac{50}{10} = 5$$

6. $\frac{2}{3} : 5\frac{1}{2} :: \$3\frac{1}{2} : ? = \$25.20.$

7. 7 times 100 lb. butter @ 24¢ = \$168.00
 16 doz. eggs @ 18¢ = 2.88
 Total, \$170.88

50 lb. sugar @ 5½¢ = \$2.75
 18 yd. cloth @ \$1.37½ = 24.75
 \$27.50

\$170.88 - \$27.50 = \$143.38, the amount of money received.

8. $\frac{1}{2}$ of A's money = $\frac{1}{4}$ of B's money ;
 A's money = $\frac{1}{2}$, or $1\frac{1}{2}$, times B's money ;
 the difference, or $\frac{1}{2}$, of B's money = \$18 ;
 B's money = \$36 ; \$18 + \$36 = \$54, A's money.

9. $4\frac{1}{2} \times 1\frac{1}{2} = 1\frac{1}{2}\frac{7}{2}$ sq. yd. of broadcloth ;
 $1\frac{1}{2}\frac{7}{2} \div \frac{1}{8} = 15\frac{7}{2}$, the number yd. silk required for lining.

10. $3580 \div 2000 = 1.79$, the number of tons ;
 $\$6.50 \times 1.79 = \11.635 , the cost.

11. 4 times 36.5 yd. = 146 yd., the distance around the field ;
 4 times 146 yd. = 584 yd., the length of 4 lines of fence ;
 $584 \div 8 = 73$, the number of pounds of wire ;
 $\$.06 \times 73 = \4.38 , the cost of the wire.

12. $\frac{1}{5}$ of 640 acres = 200 acres, the land bought ;
 $\frac{1}{4}$ of 200 acres @ \$14.50 per acre = \$1740
 $\frac{1}{4}$ of 200 acres @ \$15.75 per acre = 1260

Therefore he received for the land sold \$3000

\$3000 - \$2500 = \$500, the sum gained.

13. Each boy receives $\frac{1}{4}$ of a dollar as often as each girl receives \$1. The 5 boys receive $1\frac{1}{4}$ of a dollar as often as the 4 girls receive $\frac{1}{4}$ of a dollar. As often as both receive $1\frac{1}{4}$ of a dollar, the boys receive $1\frac{1}{4}$ and the girls $\frac{1}{4}$ of a dollar. Therefore the boys' share is $1\frac{1}{4}$ of \$7.75, or \$3.75, and each boy receives $\frac{1}{5}$ of \$3.75, or 75¢. The girls' share is $1\frac{1}{4}$ of \$7.75, or \$4, and each girl receives $\frac{1}{4}$ of \$4, or \$1.

Page 351.

14. 10 miles = 633,600 inches. Since he steps 60 inches in 3 seconds, he steps 20 inches per second, and it will require as many seconds to step 633,600 inches as 20 inches are contained times in 633,600 inches, or 31,680 seconds. $31,680 \text{ sec.} = 8 \text{ hr. } 48 \text{ min.}$, the time required.

15. A can do $\frac{1}{2}$ of the work in 1 day ;
 B can do $\frac{1}{3}$ of the work in 1 day ;
 C can do $\frac{1}{6}$ of the work in 1 day .

All working together can do $\frac{1}{2} + \frac{1}{3} + \frac{1}{6}$, or $\frac{2}{3}$, of the work in 1 day. They can, therefore, do the work in $\frac{3}{2}$ of 180 da., or $4\frac{1}{2}$ da.

16. $40 \times 9\frac{1}{2} = 380 \text{ sq. ft.}$, the area ; $380 \div 9 = 42\frac{2}{3} \text{ sq. yd.}$;
 $\$.35 \times 42\frac{2}{3} = \147.78 , the cost.

17. He paid $1\frac{1}{2}$ ¢ apiece for the oranges, and sold them for $1\frac{3}{4}$ ¢ apiece ; therefore he gained $\frac{1}{4}$ of a cent on an orange. He must sell as many to gain 70¢ as $\frac{1}{4}$ ¢ is contained times in 70¢, which is 160 times. Therefore he must have bought 160 oranges.

18. The whole estate — $(\frac{1}{3} + \frac{1}{2} + \frac{1}{6})$ of the estate = $\frac{1}{2}$ of the estate ;
 $\frac{1}{2}$ of the estate = \$1850 ; the value of the estate = \$22,200.

19. $3 + 4 + 5 = 12$; $\frac{3}{12}$ of 480 bu. = 120 bu., the quantity of wheat ;
 $\frac{4}{12}$ of 480 bu. = 160 bu., the quantity of oats ;
 $\frac{5}{12}$ of 480 bu. = 200 bu., the quantity of corn.

20. $8450 \times 3580 = 30,251,000 \text{ sq. ft.}$, the area ;
 $30,251,000 \text{ sq. ft.} \div 43,560 = 694 \text{ A. } 74.78 \text{ sq. rd.}$

21. $80 \times 5 \times 4 = 1600 \text{ cu. ft.}$ $1600 \div 128 = 12\frac{1}{2}$, the number of cords.

22. After investing $\frac{2}{5}$ of his capital in bank stock $\frac{3}{5}$ was left. He invested $\frac{1}{4}$ of $\frac{3}{5}$, or $\frac{3}{20}$, of it in real estate, and had $\frac{9}{20}$ left. Therefore $\frac{9}{20}$ of his capital = \$4260 ; $\frac{1}{5}$ of it = \$1420 ; his entire capital = \$28,400.

23. $56 \times 9 = 504$, the number of square feet. Since the area divided by either dimension will give the other, therefore $504 \div 18\frac{2}{3} = 26\frac{2}{3}$, the number of feet in length.

$$24. \left. \begin{array}{l} 2\frac{1}{2} : 6\frac{1}{2} \\ 1 : 1\frac{1}{2} \end{array} \right\} :: 14 \text{ oz.} : ? \quad \frac{14 \text{ oz.} \times 6\frac{1}{2} \times 1\frac{1}{2}}{2\frac{1}{2}} = 50\frac{3}{4} \text{ oz.}$$

25. The difference between $\frac{1}{4}$ and $\frac{1}{5}$ of the number is $\frac{1}{20}$ of the number. Since $\frac{1}{20}$ of the number is 132, the number is 20 times 132, or 1584.

26. $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$. The number $+ \frac{5}{6}$ of the number $= 1\frac{1}{6}$, or $\frac{7}{6}$, of the number. $\frac{7}{6}$ of the number $= 943$; $\frac{1}{6}$ of it $= 23$; the number $= 690$.

Page 352.

27. Since $\$65 = \frac{1}{3}$ of the cost per acre of B's farm,
 $\$13 = \frac{1}{9}$ of the cost; and $\$78 =$ the cost per acre;
 $\$78 \times 160 = \$12,480$, the cost of B's farm.

28. $\frac{3}{4} \times \frac{4}{3} = 1$. Since he received $\pounds 1260$ for $\frac{1}{4}$ of the ship, the ship is worth 4 times $\pounds 1260$, or $\pounds 5040$. $\$4.8665 \times 5040 = \$24,527.16$.

29. Since 30 miles equals 30 times 320 rods, or 9600 rods, and 9600 rods equals 9600 times $16\frac{1}{2}$ feet, or 158,400 feet, 30 miles equals 158,400 feet.

Since 1 hour equals 60 minutes, and 60 minutes equals 60 times 60 seconds, or 3600 seconds, 1 hour equals 3600 seconds.

Therefore, if a train runs 30 miles an hour, it runs 158,400 feet in 3600 seconds, and in 1 second it runs $\frac{1}{3600}$ of 158,400 feet, or 44 feet.

Or, using cancellation, the number of feet that the train runs per second is

$$\frac{30 \times 320 \times 16\frac{1}{2}}{60 \times 60}, \text{ or } \frac{30 \times 320 \times 33}{60 \times 60 \times 2}, \text{ or } 44.$$

30. Since 2 oxen eat as much as 7 sheep, B's 8 oxen and 28 sheep will eat as much as 16 oxen, and C's 56 sheep will eat as much as 16 oxen. Therefore

20 oxen in $5\frac{1}{2}$ mo. will eat as much as 110 oxen in 1 month;

16 oxen in 6 mo. will eat as much as 96 oxen in 1 month;

16 oxen in $6\frac{1}{2}$ mo. will eat as much as 104 oxen in 1 month;

the whole number of oxen will eat as much as 310 oxen in 1 month.

Therefore $\frac{110}{310}$ of $\$155 = \55 , A's share,

$\frac{96}{310}$ of $\$155 = \48 , B's share;

$\frac{104}{310}$ of $\$155 = \52 , C's share.

144 A KEY TO THE STANDARD ARITHMETIC.

31. $\$.174\frac{1}{4} =$ the interest on \$1 for given time at 5% ;
 $\$.174\frac{1}{4} \times 460 = \80.05 , the interest on \$460.
32. $\$1.00 + \$.20 = \$1.20$, selling price of \$1 of goods ;
 $\$1.20 + \$1.25 = \$.96$, cost of \$1 of goods to make 25% ;
 $\$1.00 - \$.96 = \$.04$, difference in cost on each \$1 of goods to make 25%.

To make a difference of \$60, as many dollars' worth of goods must be purchased as \$.04 is contained times in \$60, or \$1500 worth was purchased.

33. If $\frac{1}{2}$ of the food was unfit for use, each man could be allowed $\frac{1}{2}$ of 15 oz., or $13\frac{1}{2}$ oz., per day.

34. Since 5 oxen eat as much as 7 horses, 3 oxen and 4 horses will eat as much as $8\frac{1}{2}$ horses. Therefore

$$8\frac{1}{2} \text{ horses} : 7 \text{ horses} :: 60 \text{ da.} : ? \quad \frac{60 \text{ da.} \times 7}{8\frac{1}{2}} = 51\frac{2}{11} \text{ da.}$$

35. The cost of the coal is the present worth of \$4 for 4 mo. @ 6%, or \$3.92. In order to gain 20% I must receive 120% of \$3.92, which is \$4.70.

36. The bank discount of \$1080 for 6 mo. 3 da @ 6% is \$32.94 ;
 $\$1080 - \$32.94 = \$1047.06$, the proceeds ;
 $\$1047.06 - \$900 = \$147.06$, the gain.

Page 353.

37. $4\frac{1}{2}$ bu. $\times 100 = 466\frac{2}{3}$ bu., the wheat needed for 100 barrels of flour. Since the miller took $\frac{1}{3}$ for grinding, the amount used for flour was only $\frac{2}{3}$ of the quantity taken to mill. Therefore

$$\begin{aligned} 466\frac{2}{3} \text{ bu.} \div \frac{2}{3} &= 533\frac{1}{3} \text{ bu.}, \text{ the quantity taken to mill ;} \\ \$.02\frac{1}{2} \times 533\frac{1}{3} &= \$12, \text{ the expense of taking it to mill ;} \\ \$.45 \times 100 &= \$45, \text{ the cost of the barrels ;} \\ \$.25 \times 100 &= \$25, \text{ the commission ;} \\ &\underline{\hspace{1.5cm}} \\ &= \$82, \text{ the whole expenses.} \end{aligned}$$

$$\begin{aligned} \$550 + \$165 + \$100 &= \$815, \text{ the receipts ;} \\ \$815 - \$82 &= \$733, \text{ the net receipts ;} \\ \$1.45 \times 533\frac{1}{3} &= \$773.33\frac{1}{3}, \text{ the amount offered ;} \\ \$773.33\frac{1}{3} - \$733 &= \$40.33\frac{1}{3}, \text{ the loss.} \end{aligned}$$

38. $80 \times 45 = 3600$ sq. rd., the area of the field ;
 $\sqrt{3600}$ sq. rd. = 60 rd., one side of the square field ;
 $2(80 \text{ rd.} + 45 \text{ rd.}) = 250$ rd., the distance around rectangular field ;
 4 times 60 rd. = 240 rd., the distance around square field ;
 $250 \text{ rd.} - 240 \text{ rd.} = 10$ rd., the difference in distance around fields ;
 $16\frac{1}{2} \text{ ft.} \times 10 = 165 \text{ ft.}$

39. $\$360 \times .03 = \10.80 , the bank discount ;
 $\$360 + 1.03 = \349.514 ;
 $\$360 - \$349.514 = \$10.486$, the true discount ;
 $\$10.80 - \$10.486 = \$.314$, the difference.

40. 5% of $\$1675.80 = \83.79 , the commission for selling ;
 $2\frac{1}{2}\%$ of $\$3860 = 96.50$, the commission for buying ;
 $\$180.29$, the total commissions.

41. $4\frac{1}{2} \text{ ft.} \times 3.1416 = 14.1372 \text{ ft.}$, the circumference of large wheel ;
 $14.1372 \text{ ft.} \times 720 = 10,178.784 \text{ ft.}$, the distance traveled ;
 $4 \text{ ft.} \times 3.1416 = 12.5664 \text{ ft.}$, the circumference of small wheel ;
 $10,178.784 \text{ ft.} \div 12.5664 \text{ ft.} = 810$, the number of revolutions of small wheel.

42. Since A has $\frac{5}{8}$ of the estate, B and C together must have $\frac{3}{8}$;
 since B has twice as much as C, C has $\frac{1}{4}$ of remaining $\frac{3}{8}$ of estate,
 which is $\frac{3}{8}$ of the estate.

A's share - C's share, or $\frac{5}{8} - \frac{1}{8} = \frac{4}{8}$ of the estate ;
 $\frac{4}{8}$ of the estate = 56 acres ; $\frac{1}{8}$ of the estate = 7 acres ;
 the entire estate = 252 acres.

43. $\$1.135 =$ amount of $\$1$ for 2 yr. 3 mo. at 6% ;
 $\$1200 \div \$1.135 = 1057.268$;
 Therefore the present worth is $\$1057.268$.

44. Since a degree of longitude on the equator is 69.16 statute miles,
 and the equator is 360° in circumference, the circumference of the
 earth is $69.16 \text{ mi.} \times 360$, or 24,897.6 miles.

45. Since A's share of the gain was $\$500$, he furnished $\frac{4}{13}$, or $\frac{4}{13}$,
 of the stock ; B therefore furnished $\frac{4}{13}$ of the stock.

Therefore $\frac{4}{13}$ of the stock = $\$1800$; $\frac{1}{13}$ of the stock = $\$100$;
 $\frac{2}{13}$ of the stock = $\$2500$, A's stock.

Page 354.

46. $17 \times 17 = 289$, the square inches in one face of cube ;
 $289 \text{ sq. in.} \times 6 = 1734 \text{ sq. in.}$, the entire surface of cube.
47. $\$4956 - \$2850 = \$2106$, the cost of 13 horses at $\$12$ more apiece ;
 $\$12 \times 13 = \156 ;
 $\$2106 - \$156 = \$1950$, the cost of 13 horses at the price paid ;
 $\$1950 \div 13 = \150 , the cost of 1 horse ;
 $\$2850 \div \$150 = 19$, the number of horses bought.

48. Since he bought 20 bu. of wheat and 15 bu. of corn for $\$36$, he could have bought 60 bu. of wheat and 45 bu. of corn for $\$108$.

Since he bought 15 bu. of wheat and 25 bu. of corn for $\$32.50$, he could have bought 60 bu. of wheat and 100 bu. of corn for $\$130$.

Since he could buy 60 bu. of wheat and 45 bu. of corn for $\$108$, or 60 bu. of wheat and 100 bu. of corn for $\$130$, the difference in the quantities of corn must have caused the difference in the sums paid ; that is, 55 bu. of corn cost $\$22$, and the corn cost $\$.40$ per bushel.

Since 20 bu. of wheat and 15 bu. of corn cost $\$36$, and 15 bu. of corn cost $\$6$, the 20 bu. of wheat must have cost $\$30$, or $\$1.50$ per bushel.

49. Since each crate contains $2\frac{1}{2}$ pecks, 15 crates contain 15 times $2\frac{1}{2}$ pecks, or $41\frac{1}{2}$ pecks, or $41\frac{1}{2}$ times 8 quarts, or 330 quarts ; and since 1 quart costs $9\frac{1}{2}$ cents, 330 quarts cost 330 times $9\frac{1}{2}$ cents, or $\$31.35$.

50. $18 \times 15 = 270 \text{ sq. ft.}$, the area of ceiling ;
 $2 \times (18 + 15) = 66 \text{ ft.}$, the distance around room ;
 $66 \times 8 = 528 \text{ sq. ft.}$, the area of walls ;
 $528 \text{ sq. ft.} + 270 \text{ sq. ft.} = 798 \text{ sq. ft.}$, the area of walls and ceiling ;
 $798 \text{ sq. ft.} - 150 \text{ sq. ft.} = 648 \text{ sq. ft.}$, the area to plaster ;
 $648 \text{ sq. ft.} \div 9 = 72$, the number of square yards to plaster ;
 $\$.30 \times 72 = \21.60 , the expense of plastering room.

51. Interest of $\$1$ for 3 mo. 3 da. @ 6% = $\$.0155$;
 $\$1 - \$.0155 = \$.9845$, the proceeds of $\$1$;
 $\$150 \div .9845 = \152.36 .

Therefore the face of the note is $\$152.36$.

52. $18 \times 1\frac{1}{2} \times 11 = 264$, the number of board feet in 1 piece of timber;

$264 \text{ ft.} \times 5 = 1320$, the number of board feet in 5 pieces;

$\$.03\frac{1}{2} \times 1320 = \46.20 , cost.

53. $\$1$ put at compound interest for 21 yr. @ 6% amounts to $\$3.399564$. Therefore it will take as many dollars to amount to $\$3000$ in that time as $\$3.399564$ is contained times in $\$3000$. $\$3000 \div \$3.399564 = 882.46$. Therefore $\$882.46$ is the sum required.

54. $\sqrt[3]{15,625} \text{ cu. ft.} = 25 \text{ ft.}$, one edge of the cube;

$25 \times 25 = 625 \text{ sq. ft.}$, the area of one face;

$625 \text{ sq. ft.} \times 6 = 3750 \text{ sq. ft.}$, the entire surface.

55. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$; $\frac{1}{4}$ of 640 acres = $160\frac{1}{2}$ acres.

56. The interest of $\$300$ for 1 yr. @ 6% = $\$18$. At the rate of $\$18$ per year it will take as many years to gain $\$300$ as $\$18$ is contained times in $\$300$, which is $16\frac{2}{3}$ times. It will, therefore, take 16 yr. 8 mo.



57. $\sqrt{50^2 - 40^2} = 30 \text{ ft.}$, the base of triangle, or the distance from the base of the building to the ladder.

Page 355.

58. $38 \times 30 \times 8 = 9120$, the number of cubic feet;

$9120 \div 27 = 337\frac{1}{3}$, the number of cubic yards;

$\$.45 \times 337\frac{1}{3} = \152.00 , the cost.

59. Since 1 share of the stock cost $\$96$, and the income from it is $\$4\frac{1}{2}$, the income is $\frac{4\frac{1}{2}}{96}$, or $4\frac{1}{16}\%$, of the investment. Since I wish to realize $4\frac{1}{8}\%$ on my investment after purchasing the other stock, and the stock yields an income of $\$5$ per share, $\$5$ must be $4\frac{1}{8}\%$ of the price I should pay per share. $\$5 \div .04\frac{1}{8} = \$106\frac{2}{3}$; therefore I must pay $\$106\frac{2}{3}$ per share.

60. $5 \times 4\frac{1}{2} \times 4 = 90 \text{ cu. ft.}$; $1728 \text{ cu. in.} \times 90 = 155,520 \text{ cu. in.}$;

$155,520 \text{ cu. in.} \div 2150.42 \text{ cu. in.} = 72.32$, the number of bushels.

148 A KEY TO THE STANDARD ARITHMETIC.

61. $\$8000 \times .04\frac{1}{2} = \360 , the income from $4\frac{1}{2}\%$ stock;
 80 shares at $\$87\frac{1}{2}$ per share = $\$7000$;
 $\$7000 \div \$116\frac{2}{3} = 60$, the number of shares at $116\frac{2}{3}$;
 $\$6000 \times .06 = \360 , income from 6% stock.

The income from both investments is the same.

62. A and B can do $\frac{1}{2}$ of the work in 1 day;
 B and C can do $\frac{1}{3}$ of the work in 1 day;
 A and C can do $\frac{1}{6}$ of the work in 1 day;
 $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6}$, twice the part that all can do in 1 day;
 $\frac{1}{2}$ of $\frac{6}{6} = \frac{3}{6} = \frac{1}{2}$, the part that all can do in 1 day;
 $\frac{1}{2} \div \frac{1}{2} = 1$ day, the time in which all can do it;
 $\frac{1}{2} - \frac{1}{3} = \frac{3-2}{6} = \frac{1}{6}$, the part A can do in 1 day;
 $\frac{1}{2} \div \frac{1}{6} = 3$ days, the time in which A can do it;
 $\frac{1}{2} - \frac{1}{6} = \frac{3-1}{6} = \frac{2}{6} = \frac{1}{3}$, the part B can do in 1 day;
 $\frac{1}{2} \div \frac{1}{3} = 1\frac{1}{2}$ days, the time in which B can do it;
 $\frac{1}{2} - \frac{1}{6} = \frac{3-1}{6} = \frac{2}{6} = \frac{1}{3}$, the part C can do in 1 day;
 $\frac{1}{2} \div \frac{1}{3} = 1\frac{1}{2}$ days, the time in which C can do it.

63. $7\frac{1}{2} \times 4 \times 2\frac{1}{2} = 82\frac{1}{2}$ cu. ft.; 1728 cu. in. $\div 82\frac{1}{2} = 142,560$ cu. in.;
 231 cu. in. $\times 31\frac{1}{2} = 7276\frac{1}{2}$, the number of cubic inches in a barrel;
 $142,560$ cu. in. $\div 7276\frac{1}{2}$ cu. in. = $19\frac{2}{3}$, the number of barrels.

64. 8 men : 56 men }
 15 weeks : 52 weeks } :: $\$32$: ?

$$\frac{\$32 \times 56 \times 52}{8 \times 15} = \$776\frac{2}{3}, \text{ or } \$776.53\frac{1}{3}.$$

65. 60 men : 12 men }
 30 ft. long : 300 ft. long }
 6 ft. high : 8 ft. high } :: 15 da. : ?
 3 ft. thick : 6 ft. thick }
 8 hr. : 12 hr. }

$$\frac{15 \text{ da.} \times 12 \times 300 \times 8 \times 6 \times 12}{60 \times 30 \times 6 \times 3 \times 8} = 120 \text{ da.}$$

66. Similar surfaces are to each other as the squares of their like dimensions. Therefore, since the diameter of the larger pipe is twice the diameter of the smaller one, 4 times the amount of water will run through the larger pipe, and $\frac{1}{4}$ of the time will be required to fill the cistern. $\frac{1}{4}$ of 2 hr. = 30 min. Or $3^2 : 1\frac{1}{2}^2 :: 2 \text{ hr.} : ?$

$$\frac{2 \text{ hr.} \times 1\frac{1}{2}^2}{3^2} = \frac{1}{2} \text{ hr., or 30 min.}$$

67. $\$4800 \div 1.20 = \$4,000$, cost of one farm ;
 $\$4800 \div .80 = \underline{\$6,000}$, cost of the other farm ;
 $\$10,000$, cost of both farms ;
 $\$4800 \times 2 = \underline{\$9,600}$, the selling price of both farms ;
 $\$400$, loss by the sale.

68. 75 shares @ $\$50$ each = $\$3750$;
 8% of $\$3750 = \300 , the amount of the dividend ;
 $\$300 \div \$50 = 6$, the number of shares the dividend would buy ;
 $75 \text{ shares} + 6 \text{ shares} = 81 \text{ shares}$, the number of shares he would then own.

69. 40 shares at $97\frac{1}{2}\%$ of $\$50 = \1950 , the cost of the stock.
 10 shares at $99\frac{1}{2}\%$ of $\$50 = \497.50
 30 shares at $101\frac{1}{4}\%$ of $\$50 = \underline{1526.25}$
 The sum received for the stock = $\$2023.75$
 $\$2023.75 - \$1950 = \$73.75$, the gain.

Page 356.

70. $18 \text{ mi.} \times 3 = 54 \text{ mi.}$
 $22 \text{ mi.} \times 4 = 88 \text{ mi.}$
 $28 \text{ mi.} \times 5 = 140 \text{ mi.}$
 $\underline{\hspace{1.5cm}}$
 $12 \) \underline{282 \text{ mi.}}$
 $23\frac{1}{2} \text{ mi., average rate per day.}$

71. Since the horse cost $\$90$, the interest on the sum borrowed to purchase him was 6% of $\$90$, or $\$5.40$, and the cost of keeping him was $\frac{1}{3}\%$ of $\$90$, or 30 cents per day, or 365 times 30 cents, or $\$109.50$ for the year ; therefore, the total expenditure was $\$90 + \$5.40 + \$109.50$,

150 A KEY TO THE STANDARD ARITHMETIC.

or \$204.90. Since the horse earned \$1 per day, in 312 days he earned \$312; and since he was sold at the end of the year for \$70, the total income was \$312 + \$70, or \$382. Hence, the liveryman gained \$382 — \$204.90, or \$177.10.

72. Since one pipe will fill the tank of 200 gal. in 15 min., $13\frac{1}{2}$ gal. must run in every minute; and since it can be emptied in 40 minutes, 5 gal. must run out every minute. Both pipes being turned on, the tank will be filled at the rate of $8\frac{1}{2}$ gal. per minute. $200 \text{ gal.} \div 8\frac{1}{2} \text{ gal.} = 24$, the number of minutes it will take to fill it.

73. Since it is 180° Fahrenheit, and 100° Centigrade from the freezing to the boiling point, the space on the thermometer is divided so that

$$180^\circ \text{ Fahr.} = 100^\circ \text{ Cent.}$$

Therefore $9^\circ \text{ Fahr.} = 5^\circ \text{ Cent.}$

When the temperature is 50° Fahr. it is 18° above the freezing point. Since 9° Fahr. are equal to 5° Cent., 18° Fahr. are equal to 10° Cent. Therefore the temperature is 10° Centigrade.

74. The agent's commission after paying the broker was 3% of the amount of the sales.

$$3\% \text{ of the amount of the sales} = \$315;$$

$$1\% \text{ of the amount of the sales} = \$105;$$

$$\text{the amount of the sales} = \$10,500;$$

$$2\% \text{ of } \$10,500 = \$210, \text{ the sum paid the broker};$$

$$\$315 + \$210 = \$525, \text{ the sum paid in commissions};$$

$$\$10,500 - \$525 = \$9975, \text{ the amount remitted.}$$

75. $\$1.00\frac{1}{2} \times 1200 = \1203 , the sum realized.

76. $\$1 + \$.00\frac{1}{2} = \$1.00125$, the cost of a sight draft for \$1;

$$\$1.00125 - \$.0105 = \$.99075, \text{ the cost of a 60-day draft for } \$1;$$

$$\$450 \div \$.99075 = 454.20. \text{ Therefore the face of the draft is } \$454.20.$$

77. (See diagram, page 124, to Ex. 12, page 333.)

$$\sqrt{18^2 + 15^2} = 23.43, \text{ the distance in feet diagonally across floor};$$

$$\sqrt{23.43^2 + 9^2} = 25.09, \text{ the distance in feet between the diagonally opposite corners}$$

78. Since $\frac{1}{9}$ of A's money = $\frac{1}{3}$ of B's money ;

$\frac{1}{9}$ of A's money = $\frac{1}{18}$ of B's money ;

and A's money = $\frac{1}{3}$ of B's money.

Since $\frac{1}{3}$ of B's money + B's money, or $\frac{4}{3}$ of B's money = \$851 ;

$\frac{1}{18}$ of B's money = \$23 ; and B's money = \$414 ;

$\frac{1}{3}$ of \$414 = \$437, A's money.

Page 357.

79. 200 lb. \times 105 = 21,000 lb., or 336,000 oz., the quantity of bread spoiled. 336,000 oz. \div 2000 = 168 oz., the decreased allowance to each man in 84 da. ; 168 oz. \div 84 = 2 oz., the decreased allowance to each man per day ; therefore each man receives but 12 oz. per day.

81. Since the net proceeds of the sale of the house were but 98 % of the selling price, 98 % of the value of the house included the cost of the city lots, and 3 % more, or 103 % of the cost of the city lots. Since 98 % of the value of the house was 103 % of the cost of the lots, the lots must have cost $\frac{98}{103}$ of the value of the house. Hence the rest, which was $\frac{5}{103}$ of the value of the house, was expended in commissions.

Therefore,

$\frac{5}{103}$ of the value of the house = \$350 ;

$\frac{1}{103}$ of the value of the house = \$70 ;

the entire value of the house = \$7210.

82. 65.20 \times 70.18 = 4575.736 sq. ch. ;

4575.736 sq. ch. \div 10 sq. ch. = 457.5736, the number of acres.

83. \$.35 \times 10 = \$3.50

\$.60 \times 12 = 7.20

\$.78 \times 7 = 5.46

29.) \$16.16

\$.557, the average value per bushel.

84. $\frac{3}{4}$ of an ounce of silver in 18 oz. of the mixture is equivalent to 1 oz. of silver in 24 oz., or that $\frac{1}{24}$ of the mixture is silver. Since there are to be 4 oz. silver in the mixture, 4 oz. must be $\frac{1}{6}$ of the mixture, and the mixture must weigh 96 oz. Since the mixture must weigh 96 oz., 32 oz. gold must be added to 64 oz. mixture, so that the mixture may be $\frac{1}{4}$ silver.

85. $250 \text{ rd.} \times 3.1416 = 785.4 \text{ rd.}$, the circumference of park ;
 $785.4 \times 62\frac{1}{2}$ ($\frac{1}{2}$ radius) = $49,087.5 \text{ sq. rd.}$, the area of park ;
 $125 \text{ rd.} + 3.1416 = 39.788 \text{ rd.}$, the diameter of the lake ;
 125×9.947 ($\frac{1}{2}$ radius) = 1243.375 sq. rd. , the area of the lake ;
 $49,087.5 \text{ sq. rd.} - 1243.375 \text{ sq. rd.} = 47,844.125 \text{ sq. rd.}$, the area
of the park exclusive of the lake ;
 $47,844.125 \text{ sq. rd.} + 160 \text{ sq. rd.} = 299.025$, the number of acres.

86. $3^3 : 9^3 :: \text{volume of small ball} : \text{volume of larger ball}$;
or, $27 : 729 :: \text{volume of small ball} : \text{volume of larger ball}$.

Therefore, since the volume of the large ball is 27 times the volume of the small ball, it will take 27 small balls to weigh as much as the large ball.

88. Since $\$225 = 85\%$ of the cost of repairing the house,
 $\$2.6471 = 1\%$ of the cost of repairing the house ;
 $\$264.71 = \text{the cost of repairing the house}$;
 $\$2700 + \$264.71 = \$2964.71$, the entire cost.

Page 358.

89. Since the third contractor received $\$500$ for superintending the work, there was $\$32,025$ to divide on the basis of the number of days' work each contractor furnished. Since the first contractor had 80 men at work for 40 days, he furnished 80 times 40, or 3200 days' work ; since the second had 70 men at work for 45 days, he furnished 3150 days' work ; and since the third had 56 men at work for 50 days, he furnished 2800 days' work ; therefore it required $3200 + 3150 + 2800$, or 9150 days' work to build the bridge, of which the first contractor furnished $\frac{3200}{9150}$, or $\frac{64}{183}$, the second $\frac{3150}{9150}$, or $\frac{21}{41}$, and the third $\frac{2800}{9150}$, or $\frac{56}{183}$. Hence the first contractor's share was $\frac{64}{183}$ of $\$32,025$, or $\$11,200$, the second's share was $\frac{21}{41}$ of $\$32,025$, or $\$11,025$, and the third's share was $\frac{56}{183}$ of $\$32,025$ plus $\$500$ for superintending, or $\$9800$ plus $\$500$, or $\$10,300$.

90. Since it costs as much to support 3 children as it does to support 2 grown persons,

4 grown persons and 3 children = 6 grown persons ;

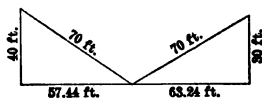
3 grown persons and 8 children = $8\frac{1}{2}$ grown persons.

6 grown persons : $8\frac{1}{2}$ persons :: $\$150$: ? $\frac{\$150 \times 8\frac{1}{2}}{6} = \$208\frac{1}{2}$.

91. $1\frac{1}{2}\%$ of $(\$3200 + \$1280) = \$61.60$, his total tax.
92. $\$60 + \$12,000 = .005$, the rate of taxation ;
 $\$8.875 \div \$.005 = 1775$.
 Therefore the residence is assessed at \$1775.
93. 425 doz. handkerchiefs @ 35 francs per doz. = 14,875 francs ;
 $\$.193 \times 14,875 = \2870.875 , the value in U. S. currency ;
 40% of $\$2870.875 = \1148.35 , the duty.
94. 56 sq. yd. $\times 40 = 2240$ sq. yd. ;
 $\$.15 \times 2240 = \336 , the specific duty ;
 3s. 8d. = \$.89219, the invoiced price per yard in U. S. currency ;
 $\$.89219 \times 2240 = \1998.5056 , the invoiced price ;
 30% of $\$1998.5056 = \599.55 , the ad valorem duty ;
 $\$336 + \$599.55 = \$935.55$, the entire duty.
95. $\$60 \div \$.87\frac{1}{2} = 68\frac{1}{2}$, the number of days the first worked ;
 $\$60 \div \$1.12\frac{1}{2} = 53\frac{1}{2}$, the number of days the second worked.
96. $\$18 : \$115 \left. \vphantom{\$18} \right\} :: \$300 : ? \quad \frac{\$300 \times 115 \times 9}{18 \times 6} = \2875 .
 6 mo. : 9 mo.
97. $\$1200$ for 8 mo. = $\$9,600$ for 1 mo., A's capital ;
 $\$900$ for 10 mo. = $9,000$ for 1 mo., B's capital ;
 $\$850$ for 12 mo. = $10,200$ for 1 mo., C's capital.
 Entire capital for 1 mo. = $\$28,800$
 A's share of the gain = $\frac{9600}{28800}$ of $\$1296$, which is $\$432$;
 B's share of the gain = $\frac{9000}{28800}$ of $\$1296$, which is $\$405$;
 C's share of the gain = $\frac{10200}{28800}$ of $\$1296$, which is $\$459$.

Page 359.

98. B is \$240 in debt at the end of 5 years, and therefore must spend \$48 more than his income every year. Since he spends \$100 more than A, A must save \$52 a year. Therefore $\frac{1}{5}$ of A's income = \$52, and his income = \$312.



$$99. \sqrt{70^2 - 40^2} = 57.44 \text{ ft.}$$

$$\sqrt{70^2 - 30^2} = 63.24 \text{ ft.}$$

$$57.44 \text{ ft.} + 63.24 \text{ ft.} = 120.68 \text{ ft.,}$$

the width of the street.

100. Since each son receives \$60 more than his next younger brother, the next to the youngest son receives \$60 more than his youngest brother, the next older son receives \$120 more than the youngest brother, the next older son \$180 more than the youngest brother. Consequently all together will receive \$360 more than 4 times the share of the youngest brother.

Since 4 times the youngest's share + \$360 = \$1200;

4 times the youngest's share = \$840;

and the youngest's share = \$210.

Hence, the shares are \$210, \$270, \$330, \$390.

101. B must gain $\frac{1}{2}$ of the distance around the pond to overtake A, and since he gains 5 yd. per minute he can gain 690 ft., or 230 yd., in 46 min.

At the rate of 50 yd. per minute, B will walk 5 times around the pond in 46 min.

102. The amount of \$1 for 9 yr. @ 6% is \$1.54;

the amount of \$1 for 5 yr. @ 6% is \$1.30.

It will take as many times \$1 to yield the same amount for 5 yr. that \$1 does for 9 yr. as \$1.30 is contained times in \$1.54, which is $1\frac{1}{2}$ times. Therefore as often as he invests for his son \$1 for 9 yr., he must invest \$ $1\frac{1}{2}$ for his daughter for 5 yr., or out of every \$ $1\frac{1}{2}$ invested, \$ $\frac{2}{3}$ is invested for the son, and \$ $\frac{1}{3}$ for the daughter. Hence the son's share is $\frac{2}{3}$ of \$1500, which is \$686.62, and the daughter's share is $\frac{1}{3}$ of \$1500, which is \$500.

103. A has \$3 as often as C has \$5. Therefore A will have $\frac{2}{3}$ of \$1200, or \$800, and C will have $\frac{1}{3}$ of \$1200, or \$400.

104. \$1650 = the cost of the lot;

\$9350 = the cost of the house and the store;

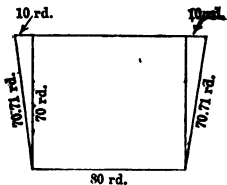
Since the cost of the store was $\frac{1}{4}$ as much as the cost of the house and lot, \$1650, the cost of the lot, + \$9350, the cost of the house and store, or \$11,000 was $\frac{5}{4}$ of the cost of the house and lot. Therefore

\$2200 = $\frac{1}{4}$ of the cost of the house and lot, or the cost of store ;

\$9350 - \$2200 = \$7150, the cost of the house.

Page 360.

105. Since the field is in the form of the figure shown in the margin, it is seen that a right-angled triangle is formed at each end by the perpendicular which is the distance between the fields, the short line which is 10 rd., and one of the two equal sides of the field. From the right-angled triangle the length of the equal sides is found to be 70.71 rd., thus : $\sqrt{70^2 + 10^2} = 70.71$.



Hence the distance around field
= 321.42 rd. ;

\$1.50 \times 321.42 = \$482.13, the cost of fencing ;

$\frac{1}{2}$ (80 rd. + 100 rd.) = 90 rd., half the sum of parallel sides ;

90 \times 70 = 6300 sq. rd., or $39\frac{3}{8}$ acres, the area ;

\$75 \times $39\frac{3}{8}$ = \$2953.125, the cost of the field ;

\$2953.125 + \$482.13 = \$3435.255, the entire cost.

106. The difference in the price per pound was $\frac{1}{2}\phi$, and the entire difference in the cost of the purchase 75 ϕ ; consequently as many pounds must have been purchased to produce a difference of 75 ϕ as $\frac{1}{2}\phi$ is contained times in 75 ϕ , or 150 lb.

107. Since the area is equal to the product of the base by $\frac{1}{2}$ the altitude, if the area is divided by $\frac{1}{2}$ the altitude, the quotient will be the base. 1 A. 65 sq. rd. = 225 sq. rd. ; 225 \div 9 = 25, the length of base in rods.

108. 160 sq. rd. \times $5\frac{1}{2}$ = 880 sq. rd. ;

880 \div 44 = 20. Therefore 20 rd. is $\frac{1}{2}$ the altitude, and the altitude is 40 rods.

109. Since $\frac{3}{4}$ of the cost of the horse = $\frac{2}{3}$ of the cost of the carriage,
 $\frac{1}{4}$ of the cost of the horse = $\frac{2}{3}$ of the cost of the carriage,
and the cost of the horse = $\frac{8}{9}$ of the cost of the carriage.

Since the cost of the horse = $\frac{8}{9}$ of the cost of the carriage, the gain by the sale of the horse was 25 %, or $\frac{1}{4}$, of $\frac{8}{9}$ of the cost of the carriage,

or $\frac{3}{4}$ of the cost of the carriage. Therefore the selling price of the horse was $\frac{1}{2}$ of the cost of the carriage.

Since the gain on the carriage was 10%, or $\frac{1}{10}$ of its cost, the selling price of the carriage was $\frac{11}{10}$ of its cost. Therefore the selling price of both was equal to $\frac{1}{2}$ of the cost of the carriage + $\frac{11}{10}$ of the cost of the carriage, or $\frac{13}{10}$ of the cost of the carriage. Hence

$$\frac{13}{10} \text{ of the cost of the carriage} = \$597;$$

$$\frac{1}{10} \text{ of the cost of the carriage} = \$3;$$

$$\text{and the cost of the carriage} = \$270;$$

$$\text{the cost of horse} = \frac{2}{3} \text{ of } \$270, \text{ or } \$240.$$

110. 20% of \$750 = \$150, the gain on the cloth;

$$16\frac{2}{3}\% \text{ of } \$500 = \$83\frac{1}{3}, \text{ the loss on the silk};$$

$$\$150 - \$83\frac{1}{3} = \$66\frac{2}{3}, \text{ the gain.}$$

111. \$2365 - \$2150 = \$215, the gain. Therefore the gain is $\frac{115}{1150}$ of the cost, or 10%.

112. Since 120% of cost = \$15.40, 1% of cost = \$.1283 $\frac{1}{3}$, and the cost = \$12.83 $\frac{1}{3}$; \$16.50 - \$.1283 $\frac{1}{3}$ = \$3.66 $\frac{2}{3}$, the gain.

113. At the end of 4 months he would have been entitled to the use of \$1200 for 2 mo., or \$1 for 2400 mo. Since he has paid all but \$800 of the debt, and he is entitled to the use of \$1 for 2400 mo., he can keep the \$800 for $\frac{1}{3}$ of 2400 mo., or 3 mo.



$$114. \sqrt{38^2 + 25^2} = 45.48 \text{ ft.}$$

Page 361.

115. $\frac{3}{4}$ of the number in 1st field = $\frac{3}{4}$ of the number in 2d field;

$$\frac{1}{4} \text{ of the number in 1st field} = \frac{1}{4} \text{ of the number in 2d field};$$

The entire number in 1st field = $\frac{3}{4}$ of the number in 2d field.

$$\frac{3}{4} \text{ of the number in 3d field} = \frac{3}{4} \text{ of the number in 2d field};$$

$$\frac{1}{4} \text{ of the number in 3d field} = \frac{1}{4} \text{ of the number in 2d field};$$

The entire number in 3d field = $\frac{3}{4}$ of the number in 2d field.

Therefore, since the number in the 1st field is $\frac{3}{4}$ of the number in the 2d field, and the number in the 3d field is $\frac{3}{4}$ of the number in the 2d

field, the number in the three fields will be equal to $\frac{2}{3} + \frac{2}{3} + \frac{2}{3}$, or $2\frac{1}{3}$, of the number in the 2d field. Hence

$2\frac{1}{3}$ of the number in 2d field = 434 ;

$\frac{1}{3}$ of the number in 2d field = 2 ;

The entire number in 2d field = 144 ;

The number in 1st field = $\frac{2}{3}$ of 144, or 162 ;

The number in 3d field = $\frac{2}{3}$ of 144, or 128.

116. 15 men : 9 men }
 75 acres : 198 acres } :: 6 da. : ?
 8 hr. : $8\frac{1}{2}$ hr. }

$$\frac{6 \text{ da.} \times 9 \times 198 \times 8\frac{1}{2}}{15 \times 75 \times 8} = 9.801 \text{ da.}$$

117. $\frac{1}{2}(20 \text{ in.} + 12 \text{ in.}) = 16 \text{ in.}$, or $1\frac{1}{3} \text{ ft.}$, the average width ;
 $18 \times 1\frac{1}{3} \times 1 = 24$, the number of board feet.

118. Interest compounded semi-annually for 3 yr. at 6% is the same as interest for 6 yr. at 3% ;

\$.194052 = interest of \$1 for 6 yr. at 3% ;

\$.194052 \times 1650 = \$ 320.185, the compound interest.

119. The interest of \$ 460.75 for 1 yr. at 6% = \$ 27.645 ;

\$ 95 \div \$ 27.645 = $3\frac{2}{3}4\frac{1}{2}$.

Therefore the time is 3 yr. 5 mo. 7 da.

120. The interest of \$ 712 for 3 yr. 4 mo. at 1% is \$ 23.73 $\frac{1}{2}$;

\$ 142.40 \div \$ 23.73 $\frac{1}{2}$ = 6. Therefore the rate is 6%.

121. Since A's stock = $\frac{2}{3}$ of B's, $\frac{2}{3}$ of B's stock = \$ 5600, and B's stock is \$ 4200.

Since B's stock = $\frac{2}{3}$ of C's, $\frac{2}{3}$ of C's stock = \$ 4200, and C's stock is \$ 3500.

A's stock = \$ 5,600

B's stock = 4,200

C's stock = 3,500

Entire stock = \$ 13,300

$\frac{5600}{13300}$, or $\frac{56}{133}$, of \$ 3192 = \$ 1344, A's gain ;

$\frac{4200}{13300}$, or $\frac{42}{133}$, of \$ 3192 = \$ 1008, B's gain ;

$\frac{3500}{13300}$, or $\frac{35}{133}$, of \$ 3192 = \$ 840, C's gain.

123. The work of 7 men } = the work of 42 men for 1 da., D's men ;
 for 6 da. }
- The work of 8 men } = the work of 40 men for 1 da., E's men ;
 for 5 da. }
- The work of 5 men } = the work of 45 men for 1 da., F's men ;
 for 9 da. }
- The work of all the } = the work of 127 men for 1 da.
 men }
- $\frac{42}{117}$ of \$ 381 = \$ 126, what D should receive ;
 $\frac{40}{117}$ of \$ 381 = \$ 120, what E should receive ;
 $\frac{45}{117}$ of \$ 381 = \$ 135, what F should receive.

123. \$ 1125 + 9 = \$ 125, A's gain for 1 mo. ;
 \$ 1200 + 12 = 100, B's gain for 1 mo. ;
 \$ 1275 + 15 = 85, C's gain for 1 mo. ;

Entire gain for 1 mo. = \$ 310

Since the gain per month is proportional to the capital invested,

$$\frac{1}{3}\frac{1}{10} \text{ of } \$ 18,600 = \$ 7500, \text{ A's capital ;}$$

$$\frac{1}{11}\frac{1}{10} \text{ of } \$ 18,600 = \$ 6000, \text{ B's capital ;}$$

$$\frac{1}{3}\frac{1}{10} \text{ of } \$ 18,600 = \$ 5100, \text{ C's capital.}$$

124. Since the man bought the farm for \$ 2500 and sold it for \$ 3000, if there had been no expense, his gain would have been \$ 3000 - \$ 2500, or \$ 500 ; but the buying cost him 2% of \$ 2500, or \$ 50, and the selling 2% of \$ 3000, or \$ 60 ; therefore the expense was \$ 50 + \$ 60, or \$ 110, and the net gain was \$ 500 - \$ 110, or \$ 390 ; consequently since \$ 390 is $\frac{390}{2500}$, or .156 of \$ 2500, the gain was 15.6% of the cost.

Page 362.

125. $\sqrt{1} : \sqrt{6\frac{1}{4}} :: 8 \text{ ft.} : ?$ $\frac{8 \text{ ft.} \times 2.5}{1} = 20 \text{ ft.}$

126. $\frac{1}{100}$ of 500 lb. = 5 lb., or 240 oz., the weight of oak ashes ;
 $\frac{1}{100}$ of 240 oz. = 2.4 oz., the weight of carbonate of potash.

129. Since A has $\frac{1}{4}$ as much as B, for every \$4 B has A has \$3. Since C has $\frac{1}{3}$ as much as A and B, for every \$7 A and B have C has \$3. Therefore for every \$3 which A has B has \$4 and C \$3. Hence A has $\frac{3}{10}$ of \$4750, or \$1425; B has $\frac{4}{10}$ of \$4750, or \$1900; C has $\frac{3}{10}$ of \$4750, or \$1425.

130. Since he bought the stock at \$75 per share, and sold it at \$120 per share, he gained \$45 on an investment of \$75, or 60%, by the transaction; 60% of the sum invested = \$1560; 1% of the sum invested = \$26; amount invested = \$2600.

131. $\$300 \div 1.25 = \240 , the cost of one carriage;
 $\$300 \div .75 = \400 , the cost of the other carriage;
 $\$240$, the cost of both carriages;
 $\$300 \times 2 = 600$, the selling price of both carriages;
 $\$40$, the loss by the sale.

Therefore the loss was $\frac{40}{600}$, or $6\frac{2}{3}\%$, of the cost.

132. $15)74^{\circ} \quad 3'$, the difference in longitude;
 $4 \text{ hr. } 56 \text{ min. } 12 \text{ sec.}$, the difference in time.

133. $74^{\circ} \quad 3'$ W., longitude of New York;
 $2^{\circ} \quad 20'$ E., longitude of Paris;
 $15)76^{\circ} \quad 23'$, the difference in longitude;
 $5 \text{ hr. } 5 \text{ min. } 32 \text{ sec.}$, the difference in time.

134. An ounce of gold weighs $\frac{1}{18}$ of 5760 grains, or 480 grains;
 an ounce of lead weighs $\frac{1}{18}$ of 7000 grains, or $437\frac{1}{2}$ grains;
 the difference = $42\frac{1}{2}$ grains.

Therefore an ounce of gold is $42\frac{1}{2}$ gr. heavier than an ounce of lead.

135. $\frac{2}{3}$ of \$900 = \$600;
 $\$3.75 \div \$600 = .006\frac{1}{4} = .6\frac{1}{4}\%$, the rate of premium.

136. Value of ship + value of cargo = \$60,000;
 $\frac{2}{3}$ of \$60,000 = \$40,000, the sum insured;
 $1\frac{1}{4}\%$ of \$60,000 = \$500, cost of insurance.



137. $\sqrt{40^2 + 8^2} = 40.79$ ft., AB , the length of the ladder. Therefore in the right-angled triangle DCE , CE is 30 ft., and DE is 40.79 ft. Therefore $\sqrt{40.79^2 - 30^2} = 27.64$ ft., DC .

138. $56,724$ lb. = 28.362 tons;

$\$8\frac{1}{2} \times 28.362 = \233.99 , value of the hay.

139. $3 \times 4 \times 3\frac{1}{2} \times 7\frac{1}{2} = 315$ cu. ft. in 3 loads of wood;

315 cu. ft. $\div 128 = 2\frac{5}{8}$ cd.; $\$3.75 \times 2\frac{5}{8} = \9.228 , cost.

140. 5 mi. 28 rd. 2 yd. = $5\frac{3}{40}$ mi.; $\$12,760 \times 5\frac{3}{40} = \$64,931$.

141. $4 \times 3 \times 2\frac{1}{2} = 30$ cu. ft.; 1728 cu. in. $\times 30 = 51,840$ cu. in.;

$51,840$ cu. in. $\div 2150.42$ cu. in. = 24.1069 , the number of bushels in bin;

24.1069 bu. $\div 1.75$ bu. = 13.775 , the number of acres which can be sown with the contents of the bin.

142. John and Charles can do $\frac{1}{45}$ of the work in 1 day. Since Charles can do $\frac{2}{3}$ as much as John, both can do $\frac{5}{9}$ as much as John, and Charles does $\frac{2}{3}$, and John $\frac{3}{9}$ of the work done by both. Therefore Charles does $\frac{2}{3}$ of $\frac{1}{45}$, or $\frac{2}{135}$, of the work in 1 day, and can do the work in $101\frac{1}{2}$ days. John does $\frac{3}{9}$ of $\frac{1}{45}$ of the work, or $\frac{1}{135}$ of it, in 1 day, and can do the work in 81 days.

143. Since the field contains 24 acres, each man's cattle would graze over $\frac{1}{3}$ of the 24 acres, or 8 acres. Since A owned only 9 acres, and his cattle ate the grass upon 8 acres, he really furnished but 1 acre for the pasturage for C's cattle. B furnished 7 acres. Therefore since A furnished 1 acre and B 7 acres, A is entitled to $\frac{1}{8}$ of the $\$24$ paid by C, which is $\$3$, and B is entitled to $\frac{7}{8}$ of $\$24$, which is $\$21$.

144. $\$385 - \$175 = \$210$, the amount B received for work;

$\frac{2}{3}$ of $\$210 = \140 , the amount A received for $\frac{2}{3}$ of the time;

$\$175 - \$140 = \$35$, the amount A received for 5 days' work;

$\$35 \div 5 = \7 , the daily wages of each;

$\$175 \div \$7 = 25$, the number of days A worked;

$\$210 \div \$7 = 30$, the number of days B worked.

145. August 11th was 21 da., or $\frac{7}{10}$ of a month, before the note was due. The use of any sum of money for that time at 6% is equal to $\frac{7}{1000}$ of it. The use of any sum for 2 mo. at 6% is equal to $\frac{1}{100}$ of it. Therefore, since he was to pay such a sum that the use of it for 21 days was to equal the use of the sum unpaid for 2 mo., $\frac{1}{100}$ of the sum unpaid = $\frac{7}{1000}$ of the sum paid. The whole of the sum unpaid = $\frac{700}{1000}$ of the sum paid. Therefore $\frac{2000}{1000} + \frac{700}{1000}$, or $\frac{2700}{1000}$, or $\frac{27}{10}$, of the sum paid = \$100; $\frac{1}{10}$ of the sum paid = \$10; and the whole sum paid = \$74.07.

146. \$600 being $\frac{1}{2}$ of the entire gain, $\frac{2}{3}$ of the stock + \$500 must be $\frac{1}{2}$ of the stock, hence $\frac{2}{3}$ of the stock + \$1000 = the whole stock; therefore \$1000 must be $\frac{1}{3}$ of the stock, and the entire stock = \$5000.

Page 364.

147. Date of maturity is Sept. $24/27$. Term of discount is 74 da.

Since the note bore interest, the amount due on Sept. 27 was \$360 \times 1.0155, or \$365.58. The bank discount of this sum for 74 da. was \$4.51. \$365.58 - \$4.51 = \$361.07, the proceeds.

148. Since the hollow sphere weighs only $\frac{1}{4}$ as much as the solid sphere, a sphere of the same diameter as the inside of the hollow sphere will weigh $\frac{1}{4}$ as much as the solid sphere. Since the corresponding dimensions of similar solids are to each other as the cube roots of their volumes,

Diameter of larger sphere.	Diameter of inside sphere.	Relative volumes.
6	?	$:\!:\ \sqrt[3]{1} : \sqrt[3]{\frac{1}{4}}$
$\frac{6 \text{ in.} \times .9564}{1} = 5.738 \text{ in.}, \text{ the diameter of the inside sphere.}$		
$6 \text{ in.} - 5.738 \text{ in.} = .262 \text{ in.}, \text{ twice the thickness of the shell.}$		
$\therefore .262 \text{ in.} \div 2 = .131 \text{ in.}, \text{ the thickness of the shell.}$		

149. If the train had run on regular time it would have completed the trip in 7 hr.; but since it took 4 hr. for the 140 mi., 20 min. for the delay, and $3\frac{1}{2}$ hr. for the last 105 mi., at 30 mi. per hr., it took in all 7 hr. 50 min., and was 50 min. behind time.

150. 80% of the barrel of oil must be sold for 110% of the cost; 1% of the barrel will bring $1\frac{3}{4}\%$ of the cost, and the whole barrel will be sold for $137\frac{1}{2}\%$ of the cost. Therefore the gain will be $37\frac{1}{2}\%$.

151. Since gold, 18 carats fine, contains $\frac{1}{2}$ alloy, 2 lb. 2 oz. 15 pwt. 19 gr. must be $\frac{2}{3}$ of the mixture; hence $\frac{1}{3}$ of 2 lb. 2 oz. 15 pwt. 19 gr. will be $\frac{1}{3}$ of the mixture, or the quantity of alloy.

$$3) \underline{2 \text{ lb. } 2 \text{ oz. } 15 \text{ pwt. } 19 \text{ gr.}}$$

8 oz. 18 pwt. $14\frac{1}{2}$ gr., the quantity of alloy.

152. A, after trading, had a sum equal to $\frac{2}{3}$ of his capital; B, after trading, had $\frac{1}{2}$ as much, or a sum equal to $\frac{1}{3}$ of his capital. B therefore lost $\frac{2}{3}$ of his capital, which was \$220; hence $\frac{1}{3}$ of his capital was \$110, and his whole capital was \$550. Therefore \$550 was the capital each had at first.

153. After investing $\frac{3}{4}$ of his money in a foundry, and expending $\frac{2}{3}$ of $\frac{1}{4}$, or $\frac{1}{6}$, of it in building a house, he had left $\frac{1}{6}$, or $\frac{1}{6}$, of his money; hence $\frac{1}{6}$ of his money = \$4671, and his money = \$46,710.

154. Since $\frac{3}{4}$ of the gain = $\frac{2}{3}$ of the selling price,

$$\frac{1}{4} \text{ of the gain} = \frac{1}{6} \text{ of the selling price;}$$

$$\text{the gain} = \frac{1}{2} \text{ of the selling price.}$$

Since the gain is $\frac{1}{2}$ of the selling price, the cost per yard, \$5, must be $\frac{2}{3}$ of the selling price; hence

$$\frac{1}{3} \text{ of the selling price} = \$1\frac{2}{3}, \text{ and the selling price} = \$6\frac{2}{3} \text{ per yard; } \$6\frac{2}{3} \times 3\frac{1}{2} = \$22.22, \text{ the whole value of the goods.}$$

155. \$562 $\frac{1}{2}$ - \$409 $\frac{1}{2}$ = \$153, salary for 2 mo. without board;

$$\frac{1}{2} \text{ of } \$153 = \$76\frac{1}{2}, \text{ salary per month without board;}$$

$$\$76\frac{1}{2} \times 9 = \$688\frac{1}{2}, \text{ salary for 9 mo. without board;}$$

$$\$688\frac{1}{2} - \$562\frac{1}{2} = \$126, \text{ cost of board for 9 mo. ;}$$

$$\frac{1}{3} \text{ of } \$126 = \$42, \text{ cost of board per month.}$$

Page 365.

156. .6 = $\frac{3}{5}$, and .42 $\frac{2}{5}$ = $\frac{2}{5}$.

Since he had \$60 less than $\frac{2}{3}$ of his money left, he must have spent \$60 more than $\frac{1}{3}$ of it. Therefore

$$\frac{2}{3} \text{ of his money} + \$40 = \frac{1}{3} \text{ of it} + \$60;$$

$$\text{or, } \frac{2}{3} \text{ of his money} = \frac{1}{3} \text{ of it} + \$20.$$

Hence ($\frac{2}{3} - \frac{1}{3}$), or $\frac{1}{3}$, of his money = \$20; and his money = \$700.

157. Since the numbers have a common factor plus the same remainder, if the numbers are subtracted from one another, the results will contain the common factor without the remainder; thus:

27	48	90	174
	27	48	90
	21	42	84

The largest number that will divide all of these numbers is 21.

158. 6% of \$365,816.92 = \$21,949.015, cost of repairs;
 \$318,214.84 + \$21,949.015 = \$340,163.855, total expenses;
 \$365,816.92 - \$340,163.855 = \$25,653.065, net profits;
 \$25,653.065 ÷ 8 = \$3,206.63, the share of each.

159. The sum expended for barley was 150% of the sum expended for wheat;
 the sum expended for oats was 200% of the sum expended for wheat.

$$100\% \times 1.05, \text{ or } 105\% \text{ of sum expended for wheat} = \begin{cases} \text{selling price of} \\ \text{wheat;} \end{cases}$$

$$150\% \times 1.08, \text{ or } 162\% \text{ of sum expended for wheat} = \begin{cases} \text{selling price of} \\ \text{barley;} \end{cases}$$

$$200\% \times 1.1, \text{ or } \underline{220\%} \text{ of sum expended for wheat} = \begin{cases} \text{selling price of} \\ \text{oats;} \end{cases}$$

Therefore 487% of sum expended for wheat = \$9740;

1% of the sum expended for wheat = \$20;

the sum expended for wheat = \$2000;

150% of \$2000 = \$3000, the sum expended for barley;

200% of \$2000 = \$4000, the sum expended for oats.

160. \$1 - \$.013 = \$.987, the proceeds of \$1;

\$550 ÷ \$.987 = 557.244.

Therefore the face of the note must be \$557.244.

161. The present worth of \$440 for 1 yr. 8 mo. at 6% is \$400, and since the cash offer was \$410, he lost \$10.

162. If the point of suspension had been at the middle of the pole, each man would have carried $\frac{1}{2}$ the load; but inasmuch as the point of suspension was 6 in. from the middle, and the pole was 48 in. long, it was 30 in. from one man, and 18 from the other. Therefore one carried $\frac{2}{3}$ of the load, and the other $\frac{1}{3}$ of it.

$\frac{2}{3}$ of 240 lb. = 160 lb., and $\frac{1}{3}$ of 240 lb. = 80 lb.

163. After A gained 25%, he had a sum equal to 125% of his original stock, or $\frac{5}{4}$ of his original stock; B had then $\frac{1}{2}$ as much, or $\frac{5}{8}$ of his original stock. Therefore B's loss, \$225, was $\frac{3}{8}$ of his original stock; hence $\frac{1}{2}$ of his original stock was \$75, and his original stock, or the amount each invested, was \$600.

Page 366.

164. For the better farm he asked 150% of the price asked for the poorer farm, but this he was obliged to reduce 33 $\frac{1}{3}$ %, or $\frac{1}{3}$; consequently he sold it for $\frac{2}{3}$ of 150% of the price asked for the poorer farm, or 100% of that price.

Since he reduced the price asked for the poorer farm 20%, he received but 80% of that price.

For both farms, he received, therefore, 180% of the price asked for the poorer farm. Therefore

180% of the price asked for poorer farm = \$5580;

1% of the price asked for poorer farm = \$31;

the price asked for poorer farm = \$3100;

and the price asked for better farm = 150% of \$3100, or \$4650.

165. 97 $\frac{1}{2}$ % of \$3257 = \$3175.58, the cash price;

the present worth of \$3257 is \$3200.98;

\$3200.98 - \$3175.58 = \$25.40, the gain by paying cash.

166. Since the bonds yield \$6 interest on an investment of \$72, the rate is 8 $\frac{1}{3}$ %; therefore the bonds will be $\frac{1}{3}$ % better than mortgages.

167. 3% of the amount for which the shop was insured = \$750;

1% of the amount for which the shop was insured = \$250;

the amount for which the shop was insured = \$25,000.

168. Since he bought the goods at a discount of 25 % from the marked price, he paid but 75 % of that price ; and since he received a further cash discount of 5 %₀, he paid for them only 71½ % of the marked price.

Since the goods were sold at 110 % of the marked price, and bought at 71½ % of the marked price, there was a gain of 38¾ % on an investment of 71½ %. $.3875 + .7125 = .54\frac{3}{4}$; therefore the rate of gain was 54¾ %.

169. $$.32 \times 35,000 = \$11,200$, the sum received for oats ;
 2 % of $\$11,200 = \224 , the commission for selling ;
 $\$11,200 - \$224 = \$10,976$, the net sum from sale of oats ;
 $\$10,976 + \$4000 = \$14,976$, the amount of the commission
 for buying and the sum spent for prints ;
 $\$14,976 \div \$1.02 = 14,682.353$, the number of dollars spent for
 prints ;
 $\$14,682.353 \div \$.055 = 266,951.87$, the number of yards.

170. I owe A 150 % of the sum I owe C ;
 I owe B 133½ % of 150 %, or 200 %, of the sum I owe C.

Therefore the difference between what I owe B and what I owe C, is 100 % of what I owe C, which is \$ 800. Hence, I owe A 150 % of \$ 800, or \$ 1200 ; and B 200 % of \$ 800, or \$ 1600.

171. Since A's capital of \$ 4000 was in business for the whole time, 15 yr., that was the same as 15 times \$ 4000, or \$ 60,000, for 1 yr. ; since B's capital of \$ 5000 was in business for 10 yr., that was the same as \$ 50,000 for 1 yr. ; and since C's capital of \$ 6000 was in business for 7 yr., that was the same as \$ 42,000 for 1 yr. ; therefore, the combined capital was the same as \$ 60,000 + \$ 50,000 + \$ 42,000, or \$ 152,000 for 1 yr. ; consequently A was entitled to $\frac{60,000}{152,000}$, or $\frac{15}{38}$ of the profits, B to $\frac{50,000}{152,000}$, or $\frac{25}{76}$ of them, and C to $\frac{42,000}{152,000}$, or $\frac{7}{19}$ of them ; therefore, A's share was $\frac{15}{38}$ of \$ 18,240, or \$ 7200, B's was $\frac{25}{76}$ of \$ 18,240, or \$ 6000, and C's share was $\frac{7}{19}$ of \$ 18,240, or \$ 5040.

Page 367.

172. $113\frac{1}{4}\% + \frac{1}{4}\% = 113\frac{3}{4}\%$; and
 $113\frac{3}{4}\%$ of \$ 100, or \$ 113.375, is the cost of 1 share ;
 $\$22,675 \div \$113.375 = 200$, the number of shares.

166 A KEY TO THE STANDARD ARITHMETIC.

173. 6% stock at 84% yields $\frac{1}{2}\%$, or $7\frac{1}{2}\%$, of the investment ;
 5% stock at 72% yields $\frac{1}{2}\%$, or $6\frac{1}{2}\%$, of the investment ;
 $7\frac{1}{2}\% - 6\frac{1}{2}\% = 1\frac{1}{2}\%$, the difference in favor of 6% stock.

174. 5% stock at 75% yields $\frac{5}{4}\%$, or $6\frac{3}{4}\%$, of the investment.
 Hence I can secure the income I desire, and the rate of income
 will be $6\frac{3}{4}\%$.

175. $\$1.0075 - \$.0105 = \$.997$, the cost of \$1 of draft ;
 $\$3816.48 \div \$.997 = 3827.96$.
 Therefore the face of the draft is \$3827.96.

176. Since the horse cost twice as much as the carriage, 200% of the cost of the carriage plus 15% of 200%, or 230% of the cost of the carriage = the selling price of the horse.

100% plus 8% of 100%, or 108% of the cost of the carriage = the selling price of the carriage. Therefore

$$\begin{aligned} 230\% + 108\%, \text{ or } 338\% \text{ of the cost of the carriage} &= \$662 ; \\ 1\% \text{ of the cost of the carriage} &= \$1.9586 ; \\ \text{the cost of the carriage} &= \$195.86 ; \\ \text{the cost of the horse} &= \$195.86 \times 2 = \$391.72. \end{aligned}$$

177. $\$.0155$ = the bank discount of \$1 for 3 mo. 3 da. ;
 $\$57.50 \div \$.0155 = 3709.67$;

therefore the face of the given note was \$3709.67, and since it was $\frac{1}{3}$ of what he received for the land, 3 times \$3709.67, or

$$\begin{aligned} \$11,129.01, \text{ was the amount received for land ;} \\ \$11,129.01 \div 500 = \$22.26, \text{ the price per acre.} \end{aligned}$$

178. $(34\frac{1}{2} \times 16) \times 2 = 1112$ sq. ft., the area of both sides of roof ;
 $4 \text{ slates} \times 1112 = 4448$ slates ;
 $4448 \text{ slates} @ \$4.75 \text{ per C. will cost } \211.28 .

179. Since the article was sold at a price which was $\frac{1}{4}$ above cost, it was sold for $1\frac{1}{4}$, or $\frac{5}{4}$ of its cost.

If the cost of the article had been $\frac{2}{3}$ of what it really was, and the selling price had remained the same, the gain would have been $\frac{1}{3} - \frac{1}{4}$, or $\frac{1}{12}$ of the cost ; and since the gain would have been \$6.75, $\frac{1}{12}$ of the

cost of the article was \$6.75; therefore, $\frac{1}{20}$ of the cost of the article was $\frac{1}{20}$ of \$6.75, or \$.75; consequently $\frac{20}{20}$ of the cost of the article, or the entire cost of the article, was 20 times \$.75, or \$15.00.

180. Since each man is to use $\frac{1}{3}$ of the stone, the stone after the first has ground off his share is $\frac{2}{3}$ as large as the original stone; and since the corresponding dimensions of similar surfaces are to each other as the square roots of their areas,

$$\sqrt{1} : \sqrt{\frac{2}{3}} :: 20 \text{ in.} : ? \quad \text{Therefore}$$

20 in. $\times \sqrt{\frac{2}{3}} = 16.32$ in., the diameter of the stone when the second begins to grind;

20 in. - 16.32 in. = 3.68 in., the diameter ground off by first;

$$\sqrt{1} : \sqrt{\frac{1}{3}} :: 20 \text{ in.} : ?$$

20 in. $\times \sqrt{\frac{1}{3}} = 11.54$ in., the diameter of the stone when the third begins to grind;

16.32 in. - 11.54 in. = 4.78 in., the diameter ground off by second;

20 in. - (3.68 in. + 4.78 in.) = 11.54 in., the diameter ground off by third.

AVERAGE OF PAYMENTS.

Page 369.

$$2. \quad 300 \times 0 = \text{---}$$

$$1200 \times 3 = 3600$$

$$800 \times 4 = 3200$$

$$\begin{array}{r} \text{---} \\ 2300 \end{array} \quad \begin{array}{r} \text{---} \\ 6800 \text{ mo.} \end{array}$$

$$6800 \text{ mo.} + 2300 = 22\frac{2}{3} \text{ mo., or 2 mo. 29 da.}$$

$$3. \quad 500 \times 1 = 500$$

$$500 \times 2 = 1000$$

$$800 \times 4 = 3200$$

$$\begin{array}{r} \text{---} \\ 1800 \end{array} \quad \begin{array}{r} \text{---} \\ 4700 \text{ mo.} \end{array}$$

$$4700 \text{ mo.} + 1800 = 21\frac{1}{3} \text{ mo., or 2 mo. 18 da.}$$

168 A KEY TO THE STANDARD ARITHMETIC.

$$\begin{array}{r}
 4. \quad 1500 \times 0 = \text{---} \\
 \quad 3000 \times 1 = 3000 \\
 \quad 2000 \times 3 = \underline{6000} \\
 \quad 6500 \quad 9000 \text{ mo.}
 \end{array}$$

$$9000 \text{ mo.} \div 6500 = 1\frac{1}{13} \text{ mo.,} \\
 \text{or 1 mo. 12 da.}$$

$$\begin{array}{r}
 5. \quad 800 \times 1 = 800 \\
 \quad 800 \times 2 = 1600 \\
 \quad 800 \times 4 = \underline{3200} \\
 \quad 2400 \quad 5600 \text{ mo.}
 \end{array}$$

$$5600 \text{ mo.} \div 2400 = 2\frac{1}{3} \text{ mo.,} \\
 \text{or 2 mo. 10 da.}$$

$$\begin{array}{r}
 6. \quad 750 \times 3 = 2250 \\
 \quad 750 \times 2 = 1500 \\
 \quad 1500 \times 4 = \underline{6000} \\
 \quad 3000 \quad 9750 \text{ mo.}
 \end{array}$$

$$9750 \text{ mo.} \div 3000 = 3\frac{1}{4} \text{ mo., or 3 mo. 8 da.}$$

Page 370.

$$\begin{array}{r}
 2. \quad \text{Due Mar. 1, 1887 } 200 \times 0 = \text{---} \\
 \quad \text{June 10, 1887 } 500 \times 101 = 50,500 \\
 \quad \text{June 12, 1887 } 275 \times 103 = 28,325 \\
 \quad \text{Sept. 1, 1887 } \underline{400 \times 184 = 73,600} \\
 \quad \quad \quad 1375 \quad 152,425 \text{ da.}
 \end{array}$$

152,425 da. \div 1375 = $110\frac{1}{4}$ da. Therefore the average time of payment is 111 days after the standard date, March 1, which is June 20, 1887.

Page 371.

$$\begin{array}{r}
 3. \quad \text{Due Mar. 1, 1892 } 500 \times 0 = \text{---} \\
 \quad \text{Apr. 15, 1892 } 850 \times 45 = 38,250 \\
 \quad \text{May 20, 1892 } 375 \times 80 = 30,000 \\
 \quad \text{June 28, 1892 } \underline{650 \times 119 = 77,350} \\
 \quad \quad \quad 2375 \quad 145,600 \text{ da.}
 \end{array}$$

145,600 da. \div 2375 = $61\frac{3}{5}$ da. Therefore the average time of payment will be 61 days after the standard date, March 1, which is May 1, 1892.

4. Due Jan. 10, 1892	300 × 26 =	7,800
Apr. 15, 1892	400 × 122 =	48,800
Jan. 1, 1892	750 × 17 =	12,750
Dec. 15, 1891	300 × 0 =	—
	<u>1750</u>	<u>69,350 da.</u>

69,350 da. ÷ 1750 = 39 $\frac{3}{4}$ da. Therefore the average time of payment was 40 days after December 15, 1891, which was January 24, 1892.

5. Due Dec. 1, 1891	600 × 0 =	—
Feb. 3, 1892	400 × 64 =	25,600
Dec. 20, 1891	250 × 19 =	4,750
Dec. 10, 1891	375 × 9 =	3,375
	<u>1625</u>	<u>33,725 da.</u>

33,725 da. ÷ 1625 = 20 $\frac{1}{4}$ da. Therefore the average time of payment was 21 days after December 1, 1891, which was December 22, 1891.

6. Due Apr. 10, 1892	460 × 5 =	2,300
Apr. 5, 1892	200 × 0 =	—
May 30, 1892	200 × 55 =	11,000
Apr. 25, 1892	900 × 20 =	18,000
	<u>1760</u>	<u>31,300 da.</u>

31,300 da. ÷ 1760 = 17 $\frac{3}{8}$ da. Therefore the average time of payment was 18 days after the standard date, April 5, which was April 23, 1892.

7. Due May 25, 1892	850 × 10 =	8,500
May 15, 1892	600 × 0 =	—
July 20, 1892	500 × 66 =	33,000
June 10, 1892	960 × 26 =	24,960
	<u>2910</u>	<u>66,460 da.</u>

170 A KEY TO THE STANDARD ARITHMETIC.

66,460 da. \div 2910 = $22\frac{4}{9}$ da. Therefore the average time of payment was 23 days after the standard date, May 15, which was June 7, 1892.

8. $600 \times 0 = \text{---}$

$600 \times 2 = 1200$

$1200 \times 6 = 7200$

$\frac{2400}{8400 \text{ mo.}}$

$8400 \text{ mo.} + 2400 = 3\frac{1}{2} \text{ mo.}$

May 1 + $3\frac{1}{2} \text{ mo.} = \text{Aug.}$

16, 1892.

9. $600 \times 0 = \text{---}$

$600 \times 6 = 3600$

$300 \times 9 = 2700$

$300 \times 12 = 3600$

$\frac{1800}{9900 \text{ mo.}}$

$9900 \text{ mo.} + 1800 = 5\frac{1}{2} \text{ mo.,}$

average time of payments.

Page 373.

2.

Due.		Amount.	Days.	Product.	Paid.		Amount.	Days.	Product.
1892.					1892.				
Apr.	10	\$ 150	75	11,250	April	12	\$ 250	73	18,250
Apr.	30	400	55	22,000	May	1	200	54	10,800
May	16	100	39	3,900	June	7	400	17	6,800
June	24	500	0						
		\$ 1150		37,150			\$ 850		35,850
		850		35,850					
		\$ 300		1,300					

$1300 + 300 = 4\frac{1}{2} \text{ da.};$

June 24, 1892 - 4 da. = June 20, 1892.

AVERAGE OF PAYMENTS.

171

3.

Due.		Amount.	Days.	Product.	Paid.		Amount.	Days.	Product.
1892.					1892.				
Feb.	1	\$ 500	184	92,000	Feb.	3	\$ 500	182	91,000
Apr.	20	850	105	89,250	Feb.	28	200	157	31,400
Apr.	15	1500	110	165,000	June	18	1200	46	55,200
Aug.	3	2500	0				\$ 1900		177,600
		\$ 5350		346,250					
		1900		177,600					
		\$ 3450		168,650					

$$168,650 \div 3450 = 48\frac{1}{3} \text{ da. ;}$$

Aug. 3, 1892 - 49 da. = June 15, 1892.

4.

Due.		Amount.	Days.	Product.	Paid.		Amount.	Days.	Product.
1892.					1892.				
Feb.	1	\$ 1,800	184	331,200	Feb.	20	\$ 3,000	165	495,000
Apr.	15	3,000	110	330,000	July	21	8,000	13	104,000
July	20	4,800	14	67,200			\$ 11,000		599,000
Aug.	3	6,000	0						
		\$ 15,600		728,400					
		11,000		599,000					
		\$ 4,600		129,400					

$$129,400 \div 4600 = 28\frac{1}{4} \text{ da. ;}$$

Aug. 3, 1892 - 28 da. = July 6, 1892.

172 A KEY TO THE STANDARD ARITHMETIC.

5.

Due.		Amount.	Days.	Product.	Paid.		Amount.	Days.	Product.
1891.					1891.				
Sept.	10	\$ 500	71	35,500	July	20	\$ 400	123	49,200
Nov.	1	700	19	13,300	Aug.	20	1000	92	92,000
Oct.	8	800	43	34,400					
Nov.	20	600	0				\$ 1400		141,200
									83,200
		\$ 2600		83,200					
		1400							58,000
		\$ 1200							

$58,000 + 1200 = 48\frac{1}{2}$ da. Therefore the debt was due on Nov. 20 + 48 da., or Jan. 7, 1892. The cash balance will be the present worth of \$1200 due in 6 da. @ 6%. $\$1200 + 1.001 = \1198.80 , the cash balance.

SAVINGS BANK ACCOUNTS.

Page 375.

2.

Date.	Deposited.		Drew Out.		Interest.		Balance.	
1889.								
June 4	\$ 175	00					\$ 175	00
Sept. 14			\$ 65	00			110	00
Nov. 1	150	00					260	00
1890.								
Jan. 1					\$ 2	20	262	20
Feb. 24	200	00					462	20
July 1					5	24	467	44
July 25			120	00			347	44
Sept. 10	56	00					403	44
Dec. 3			80	00			323	44
1891.								
Jan. 1					6	46	329	90

SAVINGS BANK ACCOUNTS.

173

3.

Date.	Deposited.		Drew Out.		Interest.		Balance.	
1890.								
Jan. 1	\$ 36	50			\$ 0	12	\$ 36	50
March 17	25	38				12	36	62
						12	62	24
						20	62	44
						20	62	64
						20	62	84
Aug. 1	84	72				20	147	76
Sept. 16			\$ 36	16		49	148	25
						37	112	46
						37	112	83
						37	113	20
1891.								
Jan. 27			13	48		37	113	57
						33	100	42
March 1			17	50		33	83	25
						27	83	52
						27	83	79
June 11	50	00				27	84	06
						28	134	34
						44	134	78
						44	135	22
						45	135	67
Nov. 16	40	78				45	136	12
						45	177	35
1892.								
Jan. 1						59	177	94

ARITHMETICAL PROGRESSION.

Page 377.

2. His daily wages would form an arithmetical series of which the first term is \$.25, the common difference \$.03, and the number of terms 50. Therefore $$.25 + ($.03 \times 49) = \$1.72$, the 50th, or last day's wages.

3. The first term is therefore $16\frac{1}{2}$ ft., the common difference 2 times $16\frac{1}{2}$ ft., or $32\frac{1}{2}$ ft., and the number of terms 7. Therefore $16\frac{1}{2}$ ft. + $(32\frac{1}{2}$ ft. \times 6) = $209\frac{1}{2}$ ft., the distance it falls the seventh second.

4. $75 + (5 \times 999) = 5070$, the 1000th term.

Page 378.

5. $10 + (5 \times 9) = 55$, the 10th term.

6. $6 + (8 \times 24) = 198$, the 25th term.

8. $2 + (3 \times 49) = 149$, the last term ;

$$\frac{2 + 149}{2} \times 50 = 3775, \text{ the sum.}$$

9. $\frac{1}{10} + (\frac{1}{10} \times 99) = 10$, the last term ;

$$\frac{\frac{1}{10} + 10}{2} \times 100 = 505, \text{ the sum.}$$

10. $15 + (3 \times 10) = 45$, the number of miles traveled the 11th day ;

$$\frac{15 + 45}{2} \times 11 = 330, \text{ the entire number of miles traveled.}$$

11. Since it strikes *one* first and *twelve* last,

$$\frac{1 + 12}{2} \times 12 = 78, \text{ the whole number of strokes.}$$

12. Since the annual increase was \$6 per year, the first term \$100, and the number of years 21, an arithmetical series is formed :

$\$100 + (\$6 \times 20) = \$220$, the last term ;

$$\frac{\$100 + \$220}{2} \times 21 = \$3360, \text{ the amount due.}$$

13 $\frac{1}{2} + (99 \times \frac{1}{2}) = 25\frac{1}{2}$, the last term ;

$$\frac{25\frac{1}{2} + \frac{1}{2}}{2} \times 100 = 1287\frac{1}{2}, \text{ the sum.}$$

GEOMETRICAL PROGRESSION.

Page 379.

2. $10 \times 3^5 = 2430$, the 6th term.

3. $10 \times 4^5 = 10,240$, the 6th term.

4. His wages would form a geometrical progression in which the first term is 5, the ratio 3, and the number of terms 10. Therefore $\$.05 \times 3^9 = \984.15 , his wages for the last day.

5. $\$100 \times 1.06^5 = \133.82 , the 6th term.

6. Since the amount for the first year is 1.05 of \$520, the first term will be \$546. Therefore $\$546 \times 1.05^5 = \696.85 , the amount.

Page 380.

8. $\frac{(1024 \times 4) - 4}{4 - 1} = 1364$, the sum.

9. $\frac{(\frac{112}{3} \times 2\frac{1}{3}) - \frac{1}{3}}{2\frac{1}{3} - 1} = 4\frac{4}{7}$, the sum.

10. $\frac{2 - (\frac{1}{2} \times 0)}{1 - \frac{1}{2}} = 4$, the sum.

11. $\frac{1\frac{1}{2} \times \frac{15445}{10000} - \frac{1}{10}}{1\frac{1}{2} - 1} = \frac{222445}{10000}$, the sum.

12. $\frac{\$.01 \times 2^{21} - \$.01}{2 - 1} = \$20,971.51$, his money.

PROBLEMS IN COMPOUND INTEREST.

Page 381.

2. $\$1.593848 - \$1 = \$.593848$, compound interest of \$1 for 8 yr.
@ 6% ;

$$\$3150 + \$.593848 = 5304.387.$$

Therefore the principal is \$5304.387.

3. $\$1.795856 - \$1 = \$.795856$, compound interest of $\$1$ for 12 yr. @ 5%;

$$\$2896 \div \$.795856 = 3638.85.$$

Therefore the principal is $\$3638.85$.

4. $\$2.759031 - \$1 = \$1.759031$, compound interest of $\$1$ for 15 yr. @ 7%;

$$\$3600 \div \$1.759031 = 2046.58.$$

Therefore the principal is $\$2046.58$.

- $\$2.191123 - \$1 = \$1.191123$, compound interest of $\$1$ for 20 yr. @ 4%;

$$\$3600 \div \$1.191123 = 3022.35.$$

Therefore the principal is $\$3022.35$.

Page 382.

2. $\$503.63 \div 1000 = \$.50363$, compound interest of $\$1$ for 7 yr. By referring to compound interest table (page 272, Stand. Ar.) opposite 7 yr. we find the amount, $\$1.50363$, or the interest, $\$.50363$, in the 6% column. Therefore the rate is 6%.

3. $\$721.2384 \div 1200 = \$.601032$, compound interest of $\$1$ for 12 yr. By referring to table we find the rate to be 4%.

4. $\$901.314 \div 1800 = \$.50073$, compound interest of $\$1$ for 6 yr. By referring to table we find the rate 7%.

5. $\$4344.338 \div 2000 = \2.172169 , compound interest of $\$1$ for 15 yr. By referring to table we find the rate to be 8%.

2. $\$1000 \div 400 = \2.50 , what $\$1$ @ 6% will amount to in the same time that $\$400$ amounts to $\$1000$.

By the compound interest table $\$1$ will in 15 yr. @ 6% amount to $\$2.396558$; $\$2.50 - \$2.396558 = \$.103442$.

The interest of $\$2.396558$ for a year @ 6% = $\$.143793$.

Therefore the time required to earn $\$.103442$ will be $\frac{103442}{143793}$ of a year, or 8 mo. 18 da.

Therefore the time is 15 yr. 8 mo. 18 da.

3. $\$1500 \div 750 = \2 ; $\$1.979932 =$ amount of $\$1$ for 14 yr. @ 5%;

$$\$2 - \$1.979932 = \$.020068; 5\% \text{ of } \$1.979932 = \$.098996;$$

$$\frac{20068}{98996} \text{ of a year} = 2 \text{ mo. } 12 \text{ da. Time, } 14 \text{ yr. } 2 \text{ mo. } 12 \text{ da.}$$

4. $\$2000 \div 960 = \2.083333 ;
 $\$1.967151 =$ amount of $\$1$ for 10 yr. @ 7% ;
 $\$2.083333 - \$1.967151 = \$.116182$;
 7% of $\$1.967151 = \$.13770057$;
 $\frac{11}{117} \frac{11}{113} \frac{11}{113}$ of a year = 10 mo. 3 da. Time, 10 yr. 10 mo. 3 da.
5. $\$2500 \div 1300 = \1.92307 ; $\$1.898299 =$ amount of $\$1$ @ 6%
 for 11 yr. ;
 $\$1.92307 - \$1.898299 = \$.02477$; 6% of $\$1.898299 = \$.11389$;
 $\frac{3477}{11389}$ yr. = 2 mo. 18 da. Time, 11 yr. 2 mo. 18 da.
6. $\$4800 \div 3200 = \1.50 ;
 $\$1.480244 =$ amount of $\$1$ for 10 yr. @ 4% ;
 $\$1.50 - \$1.480244 = \$.01976$;
 4% of $\$1.480244 = \$.05921$, nearly ;
 $\frac{18}{111}$ yr. = 4 mo., nearly. Time, 10 yr. 4 mo., nearly.

ANNUITIES.

Page 384.

3. 6% of $\$800 = \48 , common difference ;
 Last term = $\$800 + \$48 \times 3 = \$944$;
 $\frac{\$944 + \$800}{2} \times 4 = \$3488$, amount of annuity.
4. Semi-annual interest at 6% for 4 yr. is equal to the interest at
 3% for 8 yr.
 3% of $\$960 = \28.80 , common difference ;
 $\$960 + \$28.80 \times 7 = \$1161.60$, last term ;
 $\frac{\$1161.60 + \$960}{2} \times 8 = \$8486.40$, amount of annuity.
5. 6% of $\$1500 = \90 , common difference ;
 $\$1500 + \$90 \times 7 = \$2130$, last term ;
 $\frac{\$1500 + \$2130}{2} \times 8 = \$14,520$, amount of annuity ;
 $\$14,520 \div \$1.48 = 9810.81$.
 Therefore $\$9810.81$ is the present worth of the annuity.

6. 8% quarterly for 3 yr. 9 mo. = 2% for 15 yr.;

2% of \$ 1800 = \$ 36, common difference;

\$ 1800 + \$ 36 × 14 = \$ 2304, last term;

$\frac{\$ 1800 + \$ 2304}{2} \times 15 = \$ 30,780$, amount due.

7. 1st term, \$ 45; last term, \$ 45; number of terms, 30;

$\frac{\$ 45 + \$ 45}{2} \times 30 = \$ 1350$, amount due in 2½ yr.;

\$ 1350 ÷ \$ 1.15 = 1173.91.

Therefore \$ 1173.91 is the present worth, or the sum which would pay the entire rent in advance.

Page 385.

2. $\frac{\$ 225 \times (1.07^5 - 1)}{1.07 - 1} = \$ 1609.49$, amount of annuity.

3. $\frac{\$ 300 \times (1.06^9 - 1)}{1.06 - 1} = \$ 3447.39$, amount of annuity.

4. $\frac{\$ 450 \times (1.05^{15} - 1)}{1.05 - 1} = \$ 9710.35$, amount of annuity.

5. $\frac{\$ 650 \times (1.03^{20} - 1)}{1.03 - 1} = \$ 17465.74$, amount of annuity.

6. $\frac{\$ 50 \times (1.06^{29} - 1)}{1.06 - 1} = \$ 1839.28$, amount of annuity.

7. $\frac{\$ 800 \times (1.05^6 - 1)}{1.05 - 1} = \$ 5441.536$, amount of annuity;

\$ 5441.536 ÷ \$ 1.340096 = 4060.55.

Therefore \$ 4060.55 is the present value.

8. $\frac{\$ 480 \times (1.06^{12} - 1)}{1.06 - 1} = \$ 8097.576$, amount of annuity;

\$ 8097.576 ÷ \$ 2.012197 = 4024.24.

Therefore the present value is \$ 4024.24.

9. $\frac{\$600 \times (1.06^{15} - 1)}{1.06 - 1} = \$13,965.58$, amount of annuity ;
 $\$13,965.58 + \$2.396558 = 5827.34$.
 Therefore its present value or cost is $\$5827.34$.

SURFACE OF SOLIDS.

Page 405.

1. $2 \text{ ft.} \times 3.1416 = 6.2832 \text{ ft.}$, the perimeter ;
 $6.2832 \times 5 = 31.416 \text{ sq. ft.}$, the lateral surface.
2. $2\frac{1}{2} \text{ ft.} \times 4 = 10 \text{ ft.}$, the perimeter of base of prism ;
 $10 \times 4 = 40 \text{ sq. ft.}$, the lateral surface.
3. $6 \text{ ft.} \times 3 = 18 \text{ ft.}$, the perimeter of base of prism ;
 $18 \times 8 = 144 \text{ sq. ft.}$, the lateral surface.
4. $2 \text{ ft.} \times 3.1416 = 6.2832 \text{ ft.}$, the perimeter ;
 $6.2832 \times 5 = 31.416 \text{ sq. ft.}$, the lateral surface ;
 $(2^2 \times .7854) \times 2 = 6.2832 \text{ sq. ft.}$, area of ends ;
 $\underline{37.6992 \text{ sq. ft.}}$, the entire surface.

Page 406.

1. $15 \text{ ft.} \times 4 = 60 \text{ ft.}$, the perimeter of base ;
 $60 \times \frac{1}{2} = 540 \text{ sq. ft.}$, the lateral surface.
2. $12 \text{ ft.} \times 3.1416 = 37.6992 \text{ ft.}$, the perimeter of base ;
 $37.6992 \times \frac{3}{2} = 376.992 \text{ sq. ft.}$, the lateral surface.
3. $20 \text{ ft.} \times 3.1416 = 62.832 \text{ ft.}$, the perimeter of base ;
 $62.832 \times \frac{2}{3} = 628.32 \text{ sq. ft.}$, the lateral surface.
4. $6 \text{ ft.} \times 8 = 48 \text{ ft.}$, the perimeter of base ;
 $48 \times \frac{3}{2} = 1920 \text{ sq. ft.}$, the lateral surface ;
 $1920 \div 9 = 213\frac{1}{3} \text{ sq. yd.}$; $\$.30 \times 213\frac{1}{3} = \64 .
5. $6 \text{ ft.} \times 3.1416 = 18.8496 \text{ ft.}$, the perimeter of base ;
 $18.8496 \times \frac{9\frac{1}{2}}{2} = 89.5356 \text{ sq. ft.}$, the lateral surface.

6. $10 \text{ ft.} \times 4 = 40 \text{ ft.}$, the perimeter of base ;
 $40 \times \frac{1}{2} = 400 \text{ sq. ft.}$, the lateral surface.
7. $8 \text{ ft.} \times 3.1416 = 25.1328 \text{ ft.}$, the perimeter ;
 $25.1328 \times \frac{1}{2} = 75.3984 \text{ sq. ft.}$, the lateral surface.
8. $10 \text{ ft.} \times 3.1416 = 31.416 \text{ ft.}$, the perimeter of base ;
 $31.416 \times \frac{1}{2} = 157.08 \text{ sq. ft.}$, the lateral surface.

Page 407.

1. $12 \text{ ft.} \times 3.1416 = 37.6992 \text{ ft.}$, perimeter of lower base ;
 $8 \text{ ft.} \times 3.1416 = 25.1328 \text{ ft.}$, perimeter of upper base ;
 $\frac{1}{2} \times (37.6992 + 25.1328) \times 8 = 251.328 \text{ sq. ft.}$, lateral surface.
2. $40 \text{ ft.} \times 4 = 160 \text{ ft.}$, perimeter of lower base ;
 $20 \text{ ft.} \times 4 = 80 \text{ ft.}$, perimeter of upper base ;
 $\frac{1}{2} \times (160 + 80) \times 25 = 3000 \text{ sq. ft.}$, lateral surface.
3. $10 \text{ ft.} \times 3.1416 = 31.416 \text{ ft.}$, perimeter of lower base ;
 $8 \text{ ft.} \times 3.1416 = 25.1328 \text{ ft.}$, perimeter of upper base ;
 $\frac{1}{2} \times (31.416 + 25.1328) \times 12 = 339.2928 \text{ sq. ft.}$, lateral surface ;
 $339.2928 \text{ sq. ft.} + 9 = 37.6992 \text{ sq. yd.}$;
 $\$.15 \times 37.6992 = \$ 5.654$, the cost.
4. $9 \text{ ft.} \times 4 = 36 \text{ ft.}$, perimeter of lower base ;
 $8 \text{ ft.} \times 4 = 32 \text{ ft.}$, perimeter of upper base ;
 $\frac{1}{2} \times (36 + 32) \times 10 = 340 \text{ sq. ft.}$, lateral surface.

The solution of the preceding example gives the area of the sides as 340 sq. ft. The area of the bottom is 9×9 or 81 sq. ft., 340 sq. ft. + 81 sq. ft. = 421 sq. ft., the area of the sides and bottom, which is the surface to be covered with sheet metal.

$$\$.08 \times 421 = \$ 33.68, \text{ the cost.}$$

1. $15^{\circ} \times 3.1416 = 706.86 \text{ sq. in.}$, the surface ;
 $706.86 + 144 = 4.908 \text{ sq. ft.}$

2. $8^2 \times 3.1416 = 201.0624$ sq. in., the surface ;
 $201.0624 \div 144 = 1.396$ sq. ft.
3. $9\frac{1}{2}$ in. $\div 3.1416 = 2.9045$ in., the diameter ;
 $9\frac{1}{2} \times 2.9045 = 26.50$ sq. in., the surface.
4. $12 \div 3.1416 = 3.8197$ ft., the diameter ;
 $12 \times 3.8197 = 45.836$ sq. ft., the surface.

VOLUME OF SOLIDS.

Page 408.

1. $1 \times 1 = 1$ sq. ft., the area of base ;
 $1 \times 2 = 2$ cu. ft., the solid contents.
2. $(1\frac{1}{2})^2 \times .7854 = 1.76715$ sq. ft., the area of base ;
 $1.76715 \times 4 = 7.0686$ cu. ft., the solid contents.
3. $20 \times 1\frac{1}{2} \times 1 = 30$ cu. ft., the solid contents of stick ;
 $\$.30 \times 30 = \9.00 , the cost.
4. $8 \times 8 = 64$ sq. ft., the area of base ;
 $64 \times 9 = 576$ cu. ft., the volume of the bin ;
 1728 cu. in. $\times 576 = 995,328$ cu. in. ;
 $995,328 \div 2150.42 = 462.852$ + bu.
5. $8^2 \times .7854 = 50.2656$ sq. ft., the area of base ;
 $50.2656 \times 7 = 351.8592$ cu. ft., the volume of the vat ;
 1728 cu. in. $\times 351.8592 = 608012.6976$ cu. in. ;
 $608012.6976 \div 231 = 2632.089$ + gal.
6. $15 \times 15 = 225$ sq. ft., the area of base ;
 $225 \times 12 = 2700$ cu. ft., the volume of the bin ;
 1728 cu. in. $\times 2700 = 4,665,600$ cu. in. ;
 $4,665,600 \div 2150.42 = 2169.622$, number of bushels ;
 $\$1.85 \times 2169.642 = \4013.80 +, value of wheat.

Page 409.

1. $6^2 \times .7854 = 28.2744$ sq. ft., the area of base ;
 $28.2744 \times \frac{2}{3} = 84.8232$ cu. ft., the solid contents.
2. $30 \times 30 = 900$ sq. ft., the area of base ;
 $900 \times \frac{2}{3} = 18,000$ cu. ft., the solid contents.
3. $6^2 \times .7854 = 28.2744$ sq. ft., the area of base ;
 $28.2744 \times \frac{2}{3} = 75.3984$ cu. ft., the solid contents ;
 $165 \text{ lb.} \times 75.3984 = 12440.736$ lb.
4. $4 \times 4 = 16$ sq. ft., the area of base ;
 $16 \times \frac{2}{3} = 42\frac{2}{3}$ cu. ft., the solid contents ;
 $171 \text{ lb.} \times 42\frac{2}{3} = 7296$ lb.
1. $20 \times 20 = 400$ sq. ft., the area of lower base ;
 $10 \times 10 = 100$ sq. ft., the area of upper base ;
 $\sqrt{400 \times 100} = 200$ sq. ft., the mean proportional ;
 $(400 + 100 + 200) \times \frac{2}{3} = 466\frac{2}{3}$ cu. ft., the volume.
2. $5^2 \times .7854 = 19.635$ sq. ft., the area of upper base ;
 $8^2 \times .7854 = 50.2656$ sq. ft., the area of lower base ;
 $\sqrt{19.635 \times 50.2656} = 31.416$, the mean proportional ;
 $(19.635 + 50.2656 + 31.416) \times \frac{2}{3} = 236.405 +$ cu. ft., the volume.

Page 410.

3. $3^2 \times .7854 = 7.0686$ sq. ft., the area of lower base ;
 $1^2 \times .7854 = .7854$ sq. ft., the area of upper base ;
 $\sqrt{7.0686 \times .7854} = 2.3562$ sq. ft., the mean proportional ;
 $(7.0686 + .7854 + 2.3562) \times \frac{2}{3} = 136.136$ cu. ft., the volume.
4. $12^2 \times .7854 = 113.0976$ sq. ft., the area of lower base ;
 $10^2 \times .7854 = 78.54$ sq. ft., the area of upper base ;
 $\sqrt{113.0976 \times 78.54} = 94.248$ sq. ft., the mean proportional ;
 $(113.0976 + 78.54 + 94.248) \times \frac{2}{3} = 857.6568$ cu. ft., the volume ;
 $(1728 \text{ cu. in.} \times 857.6568) \div 231 = 6415.718$ gal.

1. $5^3 \times .5236 = 65.45$ cu. ft., the volume.
2. $8^3 \times .5236 = 268.0832$ cu. ft., the volume.
3. $9.4248 \div 3.1416 = 3$, the diameter ;
 $3^3 \times .5236 = 14.1372$ cu. ft., the volume.
4. $18 \text{ in.} = 1\frac{1}{2} \text{ ft.}$; $(1\frac{1}{2})^3 \times .5236 = 1.76715$ cu. ft. ;
 $450 \text{ lb.} \times 1.76715 = 795.217 + \text{ lb.}$, weight of ball.
5. $(2\frac{1}{2})^3 \times .5236 = 8.181$ cu. ft., the volume.
6. $25^3 \times .5236 = 8181.25$ cu. ft., the volume.
7. $6^3 \times .5236 = 113.0976$ cu. in., the volume ;
 $(252.96 \times 7.21) \div 7000 = .2605488$ lb., weight of a cubic inch of iron ;
 $.2605488 \text{ lb.} \times 113.0976 = 29.4674 + \text{ lb.}$, weight of ball.

METRIC SYSTEM.

Page 414.

1. $15,675 \text{ cm.} \div 100,000 = .15675$ kilometers.
2. $7560 \text{ sq. m.} \div 100 = 75.6$ ares, or square dekameters.
3. $6734 \text{ cl.} \div 100 = 67.34$ liters ;
 $6734 \text{ cl.} \div 10,000 = .6734$ hektoliters.
4. $43,628 \text{ mg.} \div 1000 = 43.628 \text{ g.}$;
 $43,628 \text{ mg.} \div 1,000,000 = .043628$ kilograms.
5. A liter is equal to a cubic decimeter of which there are 1000 in a cubic meter.
 $1000 \times .75 = 750$ liters. $750 \text{ l.} = 7.5$ hektoliters.
6. $876.37 \text{ sq. cm.} \div 10,000 = .087637 \text{ sq. m.}$;
 $876.37 \text{ sq. cm.} \div 1,000,000 = .00087637$ ares.
7. A cubic centimeter of water weighs 1 gram, therefore 230.5 cu. cm. of water will weigh 230.5 g.
8. $.045 \text{ cu. m.} = 45,000 \text{ cu. cm.}$, or 45,000 g. ;
 $45,000 \text{ gr.} \div 10 = 4500 \text{ Dg.}$

9. 13 Hl. = 1300 liters ; 1300 liters = 1,300,000 cu. cm.

Since a cubic centimeter weighs 1 gram, the whole weight will be 1,300,000 g. ;

$$1,300,000 \text{ gr.} + 1000 = 1300 \text{ Kg.}$$

10. 1 cu. m. = 1,000,000 cu. cm., or 1,000,000 g. ;

$$1,000,000 \text{ gr.} = 1000 \text{ Kg.}$$

Since a liter has the volume of a cubic decimeter, or 1000 cubic centimeters, and since a gram of water has the bulk of a cubic centimeter, a liter of water must weigh 1000 grams. Hence

$$1,000,000 \text{ gr.} + 1000 \text{ gr.} = 1000, \text{ the number of liters.}$$

11. 65,750.75 l. = 65,750.75 cu. dm., or 65,750,750 cu. cm. or g. ;

$$65,750,750 \text{ cu. cm.} = 65.75075 \text{ cu. m. ;}$$

$$6,575,075 \text{ g.} = 65,750.75 \text{ Kg.}$$

12. 60 l. = 60 cu. dm., or 60,000 cu. cm. or g. ;

$$60,000 \text{ g.} = 60 \text{ Kg., the weight of water ;}$$

$$60 \text{ Kg.} \times 13.5 = 810 \text{ Kg., the weight of mercury.}$$

Page 415.

13. 1 cu. dm. = 1000 cu. cm. or g., the weight of water ;

$$1000 \text{ g.} \times 7.21 = 7210 \text{ g., the weight of iron.}$$

14. 1 cu. m. = 1,000,000 cu. cm. or g. ; 1,000,000 g. = 1000 Kg. ;

$$1000 \text{ Kg.} \times .92 = 920 \text{ Kg., the weight of ice.}$$

15. 39.37079 in. + 36 in. = 1.0936, the number of yards in a meter ;

$$\$ 2.90 \times 1.0936 = \$ 3.17, \text{ cost of a meter at } \$ 2.90 \text{ per yard.}$$

Therefore it is 17% cheaper to buy cloth at \$ 3 per meter.

16. $43.6 \times 62 = 2703.2 \text{ sq. m. ; } 2703.2 \text{ sq. m.} = 27.032 \text{ sq. Dm. ;}$

$$27.032 \text{ sq. Dm.} = 27.032 \text{ a.}$$

17. $5.3 \times 4.2 = 22.26 \text{ sq. m.}$

18. $2.6 \times 2 \times .6 = 3.12 \text{ cu. m. ; } 3.12 \text{ cu. m.} = 3120 \text{ cu. dm. or l.}$

19. $3.5 \times 3.8 = 13.3 \text{ sq. m. ;}$

$$12 \text{ steres or cu. m.} + 13.3 = .90225 \text{ m., the length of pile.}$$

20. $196 \text{ lb.} + 2.20462 \text{ lb.} = 88.9042$, the number of kilograms.
21. $3 \times 3 \times 2.5 = 22.5 \text{ cu. m.}$; $22.5 \text{ cu. m.} = 22,500 \text{ cu. dm. or l.}$;
 $22,500 \text{ l.} = 225 \text{ Hl.}$, the quantity of wheat it holds.
22. $25 \text{ cu. cm. of water will weigh } 25 \text{ g.}$;
 Mercury will weigh 13.5 times 25 g. , or 337.5 g.
23. $4 \times 3.6 \times .76 = 10.944 \text{ cu. m.}$;
 $10.944 \text{ cu. m.} = 10,944 \text{ cu. dm. or l. of water.}$
24. $6.4 \times 3 \times 2.8 = 53.76 \text{ cu. m.}$;
 $53.76 \text{ cu. m.} = 53,760 \text{ cu. dm. or l.}$; $53,760 \text{ l.} = 5376 \text{ Dl.}$;
 $5376 \div (2.9 \times 60) = 30.8965$, the number of hours.
25. $1 \text{ sq. m.} = 1.196 \text{ sq. yd.} = 10.764 \text{ sq. ft.}$;
 $60 \text{ lb.} \times 10.764 = 645.84 \text{ lb.}$, the weight per square meter.

Since $1 \text{ Kg.} = 2.20462 \text{ lb.}$, $645.84 \text{ lb.} \div 2.20462 \text{ lb.} = 292.948$, the weight in kilograms.

26. $360 \text{ bu. @ } 95\text{¢} = \342.00 , the cost of wheat;
 $2150.42 \text{ cu. in.} \times 360 = 774,151.2 \text{ cu. in.}$;
 $774,151.2 \text{ cu. in.} \div 6102 + \text{cu. in.} = 126.868$, the number of
 hektoliters in 360 bu. ;
 $\$2.95 \times 126.868 = \374.266 , the selling price;
 $\$374.26 - \$342.00 = \$32.266$, the gain.
27. $3.5 \text{ m.} = 137.79 \text{ in.}$; $1.8 \text{ m.} = 70.866 \text{ in.}$; $.8 \text{ m.} = 31.496 \text{ in.}$;
 $137.79 \times 70.866 \times 31.496 = 307,546.665 \text{ cu. in.}$;
 $307,546.665 \text{ cu. in.} = 6.592 \text{ cu. yd.}$
28. $5.2 \times 4.5 = 23.4 \text{ sq. m.}$, the area of ceiling;
 $2(5.2 + 4.5) = 19.4 \text{ m.}$, the distance around room;
 $19.4 \times 3.2 = 62.08 \text{ sq. m.}$, the area of walls;
 $62.08 + 23.4 = 85.48 \text{ sq. m.}$, the total surface to plaster;
 $\$.35 \times 85.48 = \29.918 , the cost of plastering.

Page 416.

29. 1 Hl. = 26.417 gal. ;
 3.68 Hl. = 26.417 gal. \times 3.68 = 97.21456 gal. ;
 $\$2.50 \times 97.21456 = \243.0364 , the amount received for the wine.
30. 1 cu. cm. of water weighs 1 g., or .001 Kg. ;
 2583 cu. cm. weigh 2.583 Kg.
31. 1 T. = 2000 lb. ; 4 T. = 8000 lb. ; 1 Q. = 220.46212 lb. ;
 $8000 \div 220.46212 = 36.2874$, the number of quintals in 4 tons ;
 $\$.75 \times 36.2874 = \$27.215 +$, the cost of the coal.
32. 1 Hg. = 3.52739 oz. ; 20 lb. = 320 oz. ; 20 lb. 8 oz. = 328 oz. ;
 $328 \div 3.52739 = 92.986 +$, the number of Hg.
33. 1 Km. = .621382 mi. ; 1 mi. = 5280 ft. ;
 1 Km. = 5280 ft. \times .621382 = 3280.89696 ft. ;
 $3280.89696 \div 9 = 364.544 +$, the number of revolutions.
34. 1 Dl. = 2.64175 gal. ;
 21 Dl. = 2.64175 gal. \times 21 = 55.47675 gal. ;
 $55.47675 \text{ gal.} - 43 \text{ gal.} = 12.47675 \text{ gal.}$ The cask containing 21 Dl. is the greater.
35. 1 g. = 15.43248 gr. ; 10 Hg. = 15432.48 gr. ;
 $15432.48 \div 7000 = 2.204 +$, the number of lb. Avoirdupois ;
 $15432.48 \div 5760 = 2.679 +$, the number of lb. Troy.
36. 1 cu. cm. of water weighs 1 g. ;
 1000 cu. cm. = 1 cu. dm. = 1 l. = 1.0567 qt. ;
 $1 \div 1.0567 = .946342$, the part 1 qt. is of 1 l. ;
 $.946342 \times 4 = 3.78537$, the number of l. in 1 gal. ;
 1 gal. weighs 3785.37 g.
37. 1 Kg. = 2.20462 lb. ; $\$2.20 \div 2.20462 = \$.997 +$, the price per lb.
38. 1 sq. m. = 1.196 + sq. yd. ;
 $1.196 \times 9 = 10.764$, the number of sq. ft. in 1 sq. m. ;
 $1 \div 10.764 = .0929 +$, the part 1 sq. ft. is of 1 sq. m.
39. 1 sq. m. (ca.) = 1.196 + sq. yd., or 10.764 sq. ft. ;
 $100 \div 10.764 = 9.29 +$, the number of ca. in the plot.

40. $50 \times 25 \times 12 = 15000$, the number of cu. cm. ;
 $15000 \times 2.9 = 435000$, the number of g. ; $435000 \text{ g.} = 43.5 \text{ Kg.}$;
 $1 \text{ Kg.} = 2.20462 \text{ lb.}$; $43.5 \text{ Kg.} = 2.20462 \text{ lb.} \times 43.5 = 95.9 + \text{ lb.}$,
 the weight of the granite.
41. $1 \text{ cu. cm.} = .061 \text{ cu. in.}$; $1728 \text{ cu. in.} = 1 \text{ cu. ft.}$;
 $1728 \div .061 = 28327 +$, the number of cu. cm. in 1 cu. ft. ;
 1 cu. cm. weighs 1 g. or .001 Kg. ;
 28327 cu. cm. , or 1 cu. ft., weighs 28.327 Kg.
42. $2 \text{ mi.} = 126720 \text{ in.}$; $40 \text{ rd.} = 7920 \text{ in.}$; $12 \text{ ft.} = 144 \text{ in.}$;
 $2 \text{ mi., } 40 \text{ rd., } 12 \text{ ft.} = (126720 \text{ in.} + 7920 \text{ in.} + 144 \text{ in.}) 134784 \text{ in.}$;
 $1 \text{ m.} = 39.37079 \text{ in.}$;
 $134784 \div 39.37079 = 3423.451 +$, the number of m. in 2 mi.,
 $40 \text{ rd., } 12 \text{ ft.}$
43. $1 \text{ Dl.} = 2.6417 \text{ gal.}$; $24 \text{ Dl.} = 2.6417 \text{ gal.} \times 24$, or $63.4 + \text{ gal.}$
44. $1 \text{ Kg.} = 2.20462 \text{ lb.}$;
 $50 \text{ Kg.} = 2.20462 \text{ lb.} \times 50$, or 110.231 lb. ;
 $\$5.51 \div 110.231 = \$.049 +$, the cost per lb.
45. $3 \times 2 \times 3 = 18$, the number of cu. m. ; $1 \text{ cu. m.} = 1000 \text{ cu. dm.}$;
 $18 \text{ cu. m.} = 18000 \text{ cu. dm.}$, 1 cu. dm. contains 1 l. or 1.0567 qt. ;
 18000 cu. dm. contain $1.0567 \text{ qt.} \times 18000$, or 19020.6 qt. , or
 4755.15 gal.
46. $1 \text{ Hl.} = 2.8375 \text{ bu.}$; $\$6.60 \div 2.8375 = \$.2326 -$, the price per bu.
47. 1 cu. cm. of water weighs 1 g. ; 1 cu. cm. of copper weighs 8.8 g. ;
 $1 \text{ cu. dm.} = 1000 \text{ cu. cm.}$; 1 cu. dm. of copper weighs 8800 g.,
 or 88 Hg.

Page 417.

48. $1 \text{ bu.} = 32 \text{ lb.}$; $40 \text{ bu.} = 32 \text{ lb.} \times 40 = 1280 \text{ lb.}$;
 $1 \text{ Kg.} = 2.20462 \text{ lb.}$;
 $1280 \div 2.20462 = 580.598 +$, the weight of 40 bu. in Kg.
49. $7.35 - 4.41 = 2.94$. ; $7.35 \div 2.94 = 2.5$, the specific gravity.

50. 1 cu. dm. = 1000 cu. cm.; 44 cu. dm. = 44000 cu. cm.;
 1 cu. cm. of water weighs 1 g.; 44000 cu. cm. weigh 44000 g., or
 4400 Dg.;
 44000 cu. cm. of zinc weigh 4400 Dg. \times 6.86, or 30184 Dg.
51. 1 Hl. = 26.417 gal.; 2 Hl. = 26.417 gal. \times 2, or 52.8349 gal., or
 211.336 qt.;
 $\$36.32 + 211.336 = \$171+$, the cost per qt.
52. 1 g. = 15.43248 gr.;
 $412.5 + 15.4324 = 26.729+$, the number of g. in a silver dollar.
53. 1 cm. = 10 mm.; .588 cm. = 5.88 mm.;
 $5.88 + 24 = .245$, the number of mm. in the thickness of 1 sheet.
54. 1 l. = 1.0567 qt. = 1 cu. dm. = 1000 cu. cm.;
 1 cu. cm. of water weighs 1 g. = 15.43248 gr.;
 1 l. (= 1000 cu. cm.) = 15432.48 gr.;
 $15432.48 + 7000 = 2.20464$, the number of lb. of water in 1 l.,
 or 1.0567 qt.;
 $20 \div 1.0567 = 18.926+$, the number of l. in 20 qt.;
 $2.20464 \times 18.926 = 41.725+$, the weight in lb. of 20 qt. of water;
 $41.725 \text{ lb.} \times 1.841 = 76.815+$ lb., the weight of 20 qt. of sul-
 phuric acid;
 $\$.025 \times 76.815 = \$1.92+$, the cost of the acid.
55. 1 dm. = .1 m.; 9 dm. = .9 m.;
 $5 \times .9 \times 3 = 13.5$, the number of cu. m. in the vessel;
 1,000,000 cu. cm. = 1 cu. m.; 13.5 cu. m. = 13,500,000 cu. cm.;
 1 cu. m. weighs 1 g.; 13,500,000 cu. cm. weigh 13,500,000 g.
56. 1 l. = 1 cu. dm. = 1000 cu. cm. and weighs 1000 g.;
 .264 gal., or 1 l., weighs 1000 g.;
 1 gal. = 32 gills; 32 gills \times .264 = 8.448 gills.
 Since 1 l., or 8.448 gills. weighs 1000 g.,
 $1000 \div 8.448$, or 118.371+, is the weight of 1 gill in g.
57. $2 \times 1.5 = 3$, the number of sq. m.; 1 l. contains 1 cu. dm.;
 1 Hl. contains 100 cu. dm.; 25 Hl. contains 2500 cu. dm.;
 2500 cu. dm. = 2.5 cu. m.;
 $2.5 \div 3 = .83\frac{1}{3}$, the depth of the cistern in m.
58. 1 m. = 39.37079 in.;
 $36 + 39.37079 = .9144$ the number of m. in 1 yd.;

- $\$ 1.15 \times .9144 = \$ 1.05156$, the cost of 1 yd.;
 $\$ 1.05156 \times 1.20 = \$ 1.261872$, the selling price per yd.
- 59.** 1 cu. cm. of water weighs 1 g. = 15.43248 gr. ;
 35 cu. cm. = 35 g. = 540.1368 gr. ;
 35 cu. cm. of mercury weigh 540.1368 gr. \times 13.5 or 7291.8468 gr. ;
 $7291.8468 \div 7000 = 1.0416+$, the number of lb.
- 60.** 1 l. = 1.0567 qt. ; 100 l. = 105.67 qt. ;
 $105.67 \div 4 = 26.4175$ the number of gal. in 100 l. ;
 $800 \div 26.4175 = 30.283-$, the price per gal. in francs.
- 61.** $2 \times 2 \times 2 = 8$, the number of cu. dm. ; 1 cu. dm. = 1000 cu. cm. ;
 8 cu. dm. = 8000 cu. cm. ; 1 cu. cm. of water weighs 1 g. ;
 8000 cu. cm. of water weigh 8000 g. or 800 Dg. ;
 $800 \text{ Dg.} \times 10.5 = 8400 \text{ Dg.}$, the weight of the silver ;
 $\$.20 \times 8400 = \$ 1680$, or the price of the silver.
- 62.** 1250 cu. cm. of water weigh 1250 g. ;
 $1250 \text{ g.} \times .8 = 1000 \text{ g.}$, the weight of the alcohol ;
 $1000 \text{ g.} = 15432.48 \text{ gr.}$, or 2.2046 lb.

INTEREST AND PARTIAL PAYMENTS.

Page 433.

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
2. Principal June 6, 1890,			\$ 2250.00
Int. on prin. June 6, 1893 (3 yr.),		\$ 405.00	
Int. on \$ 135 yearly int. unpaid for (2 + 1) 3 yr.,		\$ 24.30	
Total int. due June 6, 1893,	\$ 429.30		
Am't of 1st paym't June 6, 1893 (9 mo. 26 da.),	\$ 1049.33		
Balance applied to liquidate prin. ($\$ 1049.33 - \$ 429.30$),			\$ 620.03
Principal June 6, 1893,			\$ 1629.97
Int. on prin. Jan. 1, 1894 (6 mo. 25 da.),		\$ 55.69	
Sum due Jan. 1, 1894,			\$ 1685.66

Page 434.

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
3. Principal Jan. 30, 1888,			\$ 800.00
Int. on prin. Jan. 30, 1889,	\$ 48.00		
Principal Jan. 30, 1889,			\$ 800.00
Int. on prin. Jan. 30, 1890,	\$ 48.00		
Principal Jan. 30, 1890,			\$ 800.00
Int. on prin. Jan. 30, 1891,	\$ 48.00		
Principal Jan. 30, 1891,			\$ 800.00
Int. on prin. Jan. 30, 1894 (3 yr.),		\$ 144.00	
Int. on \$ 48 yearly int. unpaid for (2 + 1) 3 yr.,		\$ 8.64	
Total int. due Jan. 30, 1894,	\$ 152.64		
Sum due Jan. 30, 1894,			\$ 952.64
	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
4. Principal Oct. 5, 1891,			\$ 1000.00
Int. on prin. Oct. 5, 1892 (1 yr.),		\$ 60.00	
Am't of 1st paym't Oct. 5, 1892 (9 mo. 18 da.),	\$ 104.80		
Am't of 2d paym't Oct. 5, 1892 (3 mo. 10 da.),	\$ 208.88		
Sum of paym'ts,	\$ 308.18		
Balance applied to liquidate prin. (\$ 308.18 - \$ 60),			\$ 248.18
Principal Oct. 5, 1892,			\$ 751.87
Int. on prin. Oct. 5, 1894 (2 yr.),		\$ 90.22	
Int. on \$ 45.11 yearly int. un- paid for 1 yr.,		\$ 2.71	
Total int. due Oct. 5, 1894,	\$ 92.98		
Am't of 3d paym't Oct. 5, 1894 (10 mo. 21 da.),	\$ 158.08		
Balance to liquidate prin. (\$ 158.08 - \$ 92.98),			\$ 65.10
Principal Oct. 5, 1894,			\$ 686.77
Int. on prin. Jan. 1, 1895, (2 mo. 26 da.),	\$ 9.84		
Sum due Jan. 1, 1895,			\$ 696.61

INTEREST AND PARTIAL PAYMENTS. 191

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
5. Principal Sept. 10, 1886,			\$ 500.00
Int. on prin. Sept. 10, 1888 (2 yr.),		\$ 60.00	
Int. on \$30 yearly int. unpaid for 1 yr.,		\$ 1.80	
Total int. due Sept. 10, 1888,	\$ 61.80		
Amt. of 1st paym't Sept. 10, 1888 (5 mo. 9 da.),	\$ 20.53		
Balance of unpaid yearly int. (\$ 61.80 - \$ 20.53),		\$ 41.27	
 Principal Sept 10, 1888,			 \$ 500.00
Int. on prin. Sept. 10, 1889 (1 yr.),		\$ 30.00	
Yearly int. hitherto unpaid,		\$ 41.27	
Int. on \$41.27 unpaid yearly int. for 1 yr.,		\$ 2.48	
Total int. due Sept. 10, 1889,	\$ 73.75		
Am't of 2d paym't Sept 10, 1889 (2 mo. 9 da.),	\$ 25.29		
Balance of unpaid yearly int. (\$ 73.75 - \$ 25.29),		\$ 48.46	
 Principal Sept. 10, 1889.			 \$ 500.00
Int. on prin. Sept. 10, 1890 (1 yr.),		\$ 30.00	
Yearly int. hitherto unpaid,		\$ 48.46	
Int. on \$48.46 yearly int. hitherto unpaid for 1 yr.,		\$ 2.91	
Total yearly int. unpaid Sept. 10, 1890,		\$ 78.46	
 Principal Sept. 10, 1890,			 \$ 500.00
Int. on prin. March 19, 1891 (6 mo. 9 da.),		\$ 15.75	
Yearly int. hitherto unpaid,		\$ 78.46	
Int. on \$78.46 yearly int. unpaid for 6 mo. 9 da.,		\$ 2.47	
Int. hitherto unpaid on yearly int.,	\$ 2.91		
Total int. due March 19, 1891,	\$ 99.59		
Sum due March 19, 1891,			\$ 599.59
Reduction by paym't,			\$ 200.00
Balance due March 19, 1891,			\$ 399.59

192 A KEY TO THE STANDARD ARITHMETIC.

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
6. Principal July 1, 1885,			\$ 1250.00
Int. on prin. July 1, 1887 (2 yr.),		\$ 150.00	
Int. on \$75, yearly int. unpaid for 1 yr.,		\$ 4.50	
Total int. due July 1, 1887,	\$ 154.50		
Am't of 1st paym't July 1, 1887 (3 mo. 25 da.),	\$ 254.79		
Balance applied to liquidate prin. (\$ 254.79 - \$ 154.50),			<u>\$ 100.29</u>
Principal July 1, 1887,			\$ 1149.71
Int. on prin. July 1, 1888 (1 yr.),		\$ 68.98	
Am't of 2d paym't July 1, 1888 (1 mo.),	\$ 402.00		
Balance applied to liquidate prin. (\$ 402 - \$ 68.98),			<u>\$ 333.02</u>
Principal July 1, 1888.			\$ 816.69
Int. on prin. July 1, 1889 (1 yr.),		\$ 49.00	
Am't of 3d paym't July 1, 1889 (6 mo. 18 da.),	\$ 51.65		
Am't of 4th paym't July 1, 1889 (2 mo.),	\$ 126.25		
Sum of 3d and 4th paym'ts,	\$ 177.90		
Balance applied to liquidate prin. (\$ 177.90 - \$ 49),			<u>\$ 128.90</u>
Balance due July 1, 1889,			<u>\$ 687.79</u>
	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
7. Principal Feb. 1, 1880,			\$ 1500.00
Int. on prin. Feb. 1, 1884 (4 yr.),		\$ 360.00	
Int. on \$90 yearly int. for (3 yr. + 2 yr. + 1 yr.) 6 yr.,		\$ 32.40	
Total int. due Feb. 1, 1884,	\$ 392.40		
Am't of 1st paym't Feb. 1, 1884 (1 mo.),	\$ 100.50		
Balance of unpaid yearly int. (\$ 392.40 - \$ 100.50),		\$ 291.90	

INTEREST AND PARTIAL PAYMENTS. 198

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
Principal Feb. 1, 1884,			\$ 1500.00
Int. on prin. Feb. 1, 1886 (2 yr.),		\$ 180.00	
Int. on \$90 yearly int. unpaid for 1 yr.	\$ 5.40		
Yearly int. hitherto unpaid,		<u>\$ 291.90</u>	
Int. on \$291.90 yearly int. unpaid for 2 yr.,	<u>\$ 35.08</u>		
Total yearly int. unpaid Feb. 1, 1886,		\$ 471.90	
Total int. on yearly int. unpaid Feb. 1, 1886,	\$ 40.43		
Am't of 2d paym't Feb. 1, 1886 (18 da.),	\$ 40.12		
Balance of int. on yearly int. still unpaid (\$40.43 - \$40.12),	.31		
Principal Feb. 1, 1886,			\$ 1500.00
Int. on prin. Feb. 1, 1887 (1 yr.),		\$ 90.00	
Yearly int. hitherto unpaid,		\$ 471.90	
Int. on \$471.90 yearly int. unpaid for 1 yr.,	\$ 28.31		
Int. hitherto unpaid on yearly int.,	\$.31		
Total int. due Feb. 1, 1887,	\$ 590.52		
Am't of 3d paym't Feb. 1, 1887 (4 mo.),	\$ 918.00		
Balance applied to liquidate prin. (\$918 - \$590.52),			<u>\$ 327.48</u>
Principal Feb. 1, 1887,			\$ 1172.52
Int. on prin. Feb. 1, 1888,		\$ 70.85	
Am't due Feb. 1, 1888,			\$ 1242.87
Payment Feb. 1, 1888,			<u>\$ 400.00</u>
Balance due Feb. 1, 1888,			\$ 842.87
3. Principal April 1, 1888,			
Int. on prin. April 1, 1889,		\$ 180.00	\$ 3000.00
Am't of 1st paym't April 1, 1889 (4 mo. 26 da.),	\$ 307.30		
Balance applied to liquidate prin. (\$307.30 - \$180),			\$ 127.30

194 · A KEY TO THE STANDARD ARITHMETIC.

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
Principal April 1, 1889,			\$ 2872.70
Int. on prin. April 1, 1890 (1 yr.),		\$ 172.36	
Am't of 2d paym't April 1, 1890 (2 mo. 27 da.),	\$ 101.45		
Balance of unpaid yearly int. (\$ 172.36 - \$ 101.45),		\$ 70.91	
Principal April 1, 1890,			\$ 2872.70
Int. on prin. April 1, 1891 (1 yr.),		\$ 172.36	
Yearly int. hitherto unpaid,		\$ 70.91	
Int. on \$ 70.91 yearly int. unpaid for 1 yr.,		\$ 4.25	
Total int. due April 1, 1891,	\$ 247.52		
Am't of 3d paym't April 1, 1891 (7 mo. 11 da.),	\$ 1036.83		
Balance applied to liquidate prin. (\$ 1036.83 - \$ 247.52),			\$ 789.31
Principal April 1, 1891,			\$ 2083.39
Int. on prin. July 1, 1891 (3 mo.),		\$ 31.25	
Sum due July 1, 1891,			\$ 2114.64

Page 435.

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
2. Principal April 1, 1883,			\$ 2000.00
Int. on prin. April 1, 1886 (3 yr.),		\$ 360.00	
Int. on \$ 120, yearly int. un- paid (2 yr. + 1 yr.) 3 yr.,	\$ 21.60		
Total int. due April 1, 1886,	\$ 381.60		
1st paym't without int.,	\$ 300.00		
Balance of unpaid yearly int. April 1, 1886 (\$ 381.60 - \$ 300),		\$ 81.60	

INTEREST AND PARTIAL PAYMENTS.

195

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
Principal April 1, 1886,			\$ 2000.00
Int. on prin. April 1, 1887 (1 yr.),		\$ 120.00	
Yearly int. hitherto unpaid,		\$ 81.60	
Int. on \$ 81.60 yearly int. unpaid for 1 yr.,		\$ 4.90	
Total int. due April 1, 1887,	\$ 206.50		
2d paym't without int.	\$ 35.00		
Balance of unpaid yearly int. April 1, 1887 (\$ 206.50 - \$ 35),		\$ 171.50	
Principal April 1, 1887,			\$ 2000.00
Int. on prin. April 1, 1888 (1 yr.),		\$ 120.00	
Yearly int. hitherto unpaid,		\$ 171.50	
Int. on \$ 171.50 yearly int. unpaid for 1 yr.,		\$ 10.29	
Total int. due April 1, 1888,	\$ 301.79		
Am't 3d paym't April 1, 1888 (4 mo.),	\$ 510.00		
Balance applied to liquidate prin. (\$ 510 - \$ 301.79),			<u>\$ 208.21</u>
Principal April 1, 1888,			\$ 1791.79
Int. on prin. Feb. 1, 1889 (10 mo.),		\$ 99.59	
Sum due Feb. 1, 1889,			\$ 1881.38
	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
3. Principal Feb. 10, 1886,			\$ 3600.00
Int. on prin. Feb. 10, 1887 (1 yr.),		\$ 216.00	
1st paym't without int.,	\$ 100.00		
Balance of unpaid yearly int. Feb. 10, 1887 (\$ 216 - \$ 100),		\$ 116.00	

196 A KEY TO THE STANDARD ARITHMETIC.

	Int. on Unpaid Yearly Int.	Unpaid Yearly Int.	Principal.
Principal Feb. 10, 1887,			\$ 3600.00
Int. on prin. Feb. 10, 1889 (2 yr.),		\$ 432.00	
Int. on \$ 216 yearly int. unpaid for 1 yr.,	\$ 12.96		
Yearly int. hitherto unpaid,		\$ 116.00	
Int. on \$ 116, yearly int. unpaid for 2 yr.,	\$ 13.92		
Total int. unpaid Feb. 10, 1889,	\$ 574.88		
Am't of 2d paym't Feb. 10, 1889 (6 mo.),	\$ 618.00		
Balance applied to liquidate prin. (\$ 618 - \$ 574.88),			<u>\$ 43.12</u>
Principal Feb. 10, 1889,			\$ 3556.88
Int. on pr. Feb. 10, 1891 (2 yr.),		\$ 426.88	
Int. on \$ 213.41 yearly int. unpaid for 1 yr.,	\$ 12.80		
Total int. due Feb. 10, 1891,	\$ 439.68		
3d paym't without int.,	\$ 350.00		
Balance of unpaid yearly int. Feb. 10, 1891 (\$ 439.68 - \$ 350),		\$ 89.68	
Principal Feb. 10, 1891,			\$ 3556.88
Int. on prin. Feb. 10, 1892 (1 yr.),		\$ 213.41	
Yearly int. hitherto unpaid,		\$ 89.68	
Int. on \$ 89.68 yearly int. unpaid for 1 yr.,	\$ 5.38		
Total unpaid yearly int.,		\$ 303.04	
Principal Feb. 10, 1892,			\$ 3556.88
Int. on prin. March 10, 1892 (1 mo.),		\$ 17.78	
Yearly int. hitherto unpaid,		\$ 303.04	
Int. on \$ 303.04 yearly int. unpaid for 1 mo.,	\$ 1.52		
Int. on yearly int. hitherto unpaid,	\$ 5.38		
Total int. due March 10, 1892,	\$ 327.72		
Sum due March 10, 1892,			\$ 3884.60

Page 437.

2. Principal Feb. 1, 1890,	\$ 1000.00
Int. on prin. April 1, 1891 (1 yr. 2 mo.),	\$ 70 00
Am't due,	<u>\$ 1070.00</u>
1st paym't without interest April 1, 1891,	\$ 80.00
New principal April 1, 1891,	\$ 990.00
Int. April 1, 1892 (1 yr.),	\$ 59.40
Am't due,	<u>\$ 1049.40</u>
2d paym't without int. April 1, 1892,	\$ 30.00
New principal April 1, 1892,	\$ 1019.40
Int. April 1, 1893 (1 yr.),	\$ 61.164
Am't due,	<u>\$ 1080.564</u>
3d paym't without int.,	\$ 10.00
Am't of 4th paym't April 1, 1893 (4 mo.),	\$ 612.00
Amount of 3d and 4th paym'ts,	<u>\$ 622.00</u>
New principal April 1, 1893,	\$ 458 564
Int. Oct. 1, 1893 (6 mo.),	\$ 13.756
Am't due,	<u>\$ 472.32</u>
Am't of 5th paym't Oct. 1, 1893 (5 mo.),	\$ 205.00
Balance due Oct. 1, 1893,	<u>\$ 267.32</u>
 3. Principal March 9, 1890,	 \$ 1000.00
Int. to March 9, 1891 (1 yr.),	\$ 60.00
Am't due,	<u>\$ 1060 00</u>
Am't of 1st paym't March 9, 1891 (3 mo. 20 da.),	\$ 207.74
New principal,	\$ 852.26
Int. to March 9, 1892 (1 yr.),	\$ 51.135
Am't due,	<u>\$ 903.395</u>
2d payment without int.,	\$ 50.00
New principal March 9, 1892,	\$ 853.395
Int. to June 15, 1893 (1 yr. 3 mo. 6 da.),	\$ 64 858
Am't due,	<u>\$ 918.253</u>
3d paym't,	\$ 600.00
New principal June 15, 1893,	\$ 318.253
Int. on prin. Jan. 1, 1894 (6 mo. 16 da.),	\$ 10.396
Am't due,	<u>\$ 328.649</u>
Amount of 4th paym't Jan. 1, 1894 (2 mo.),	\$ 85.85
Balance due Jan. 1, 1894,	<u>\$ 242.799</u>

Page 438.

3. 1% of \$ 4500 = \$ 45.00
 1% of \$ 3000 = \$ 30.00
 Poll tax = \$ 2.00
 Grand List = \$ 77.00
 $55\% + 12\% \times 15\% = 82\%$
 82% of \$ 77.00 = \$ 63.14, total tax.
4. 1% of \$ 2500 = \$ 25.00
 Poll tax = \$ 2.00
 Grand List = \$ 27.00
 15% of \$ 27.00 = \$ 4.05, school tax.
5. 1% of \$ 1,206,175 = \$ 12,061.75
 1% of \$ 835,978 = \$ 8,359.78
 1025 polls at \$ 2.00 = \$ 2,050.00
 Grand List = \$ 22,471.53
 $20,295 \div 22,471.53 = .9$;
 \$.90 = the tax on one dollar of the Grand List
6. 1% of \$ 4225 = \$ 42.25
 1% of \$ 5000 = \$ 50.00
 Grand List = \$ 92.25
 90% of \$ 92.25 = \$ 83.025, his town tax
 10% of \$ 92.25 = \$ 9.225, state school tax
 \$ 92.25, total tax.

ANSWERS AND SOLUTIONS

OF THE MORE DIFFICULT PROBLEMS IN MENTAL ARITHMETIC.

DIVISION.

Page 39.

1. \$1.25. 2. 5 cents. 3. 18 cents. 4. 36 cents. 5. A, 58 acres ;
B, 42 acres. 6. 100 gallons. 7. \$2. 8. \$4. 9. \$1.25.
10. 60 cents a bushel.

Page 40.

11. 400. 12. First four men \$24 each; others \$12 each.
13. 60 cents. 14. \$480. 15. 21. 16. \$2.75. 17. 8. 18. 7.
19. 27 days. 20. 9.

Page 41.

21. 185 miles. 22. 120 miles. 23. 30. 24. \$5. 25. 10.
26. \$2250. 27. 1200 quarts. 28. 30 hours. 29. 140.

Page 42.

30. 33. 31. 90 cents. 32. \$1.25. 33. \$2. 34. One, 160 pounds ;
the other, 320 pounds. 35. \$189. 36. 20 hours. 37. \$5.
38. 5 tons. 39. 20 hours.

Page 43.

40. \$200. 41. \$300. 42. 15 cents. 43. 30 cents. 44. \$115.
45. John, 100; his father, 60. 46. A, \$60; B, \$20. 47. 5 cents.

FRACTIONS.

Page 51.

25. \$60. 26. \$48. 27. \$15. 28. 24. 29. \$18. 30. 16 years.
31. 116. 32. 100. 33. 29 pounds. 34. \$1.32. 35. 64 miles.

Page 52.

36. \$4. 37. \$80.

Page 53.

35. 5. 36. 45 cents. 37. 15. 38. 18.

Page 55.

13. 48. 14. \$10,000. 15. 25 tons. 16. 12,000 miles. 17. \$27.
18. 40. 19. 20 miles. 20. 25 years. 21. \$3.

Page 56.

16. \$3.60. 17. 35 hours. 18. 40. 19. 26 miles. 20. 1000.
21. \$8.15. 22. \$13.

Page 59.

62. $1\frac{1}{2}$ acres. 63. $1\frac{1}{10}$ hours. 64. $23\frac{2}{10}$. 65. 17. 66. 1200.
67. 42 years. 68. \$14. 69. $8\frac{1}{10}$ tons. 70. $31\frac{1}{4}$.

Page 60.

27. $\frac{7}{12}$ of the farm. 28. $\frac{5}{12}$.

Page 61.

29. 60. 30. 40 years. 31. $\frac{1}{20}$ of a dollar. 32. \$15,000. 33. $\frac{1}{16}$.
34. \$12. 35. 52. 36. \$50.

Page 64.

29. $8\frac{1}{2}$. 30. \$8. 31. \$10,000. 32. \$17. 33. 15 miles.
34. \$50. 35. \$2.70. 36. Mocha, $3\frac{1}{2}$ pounds; Java, $12\frac{1}{2}$ pounds.
37. \$250.

Page 65.

26. \$1.05. 27. 50 cents. 28. \$2.25.

Page 66.

29. $37\frac{1}{2}$ miles. 30. $17\frac{1}{2}$ miles. 31. \$78.40. 32. \$1.65.
 33. \$440. 34. \$3.45. 35. \$1.49. 36. 50 cents. 37. 94 miles.
 38. \$127.50. 39. \$2.55.

Page 67.

23. 30 miles. 24. 63 cents. 25. \$84. 26. \$20. 27. $9\frac{1}{2}$.
 28. \$45.

Page 68.

29. \$16 $\frac{1}{2}$. 30. 60. 31. 8. 32. $36\frac{3}{4}$ years. 33. John, \$10; his
 father, \$35. 34. \$110. 35. $18\frac{1}{2}$ bushels. 36. 5 acres. 37. \$30.
 38. $7\frac{7}{16}$ acres. 39. 108 bushels. 40. \$18 $\frac{1}{2}$.

Page 69.

7. 9 months. 8. 8. 9. 16 days. 10. 15. 11. 10.

Page 71.

30. $1\frac{1}{2}$ pounds. 31. 10. 32. $15\frac{1}{2}$. 33. $4\frac{1}{2}$. 34. $2\frac{1}{16}$. 65. 7.

Page 72.

66. 25. 67. 20 cents. 68. 12. 69. 10. 70. 30 pounds. 71. 50
 cents. 72. 16. 73. 5 miles. 74. 25 days. 75. $2\frac{1}{2}$ days. 76. $1\frac{1}{2}$.
 77. 19 miles. 78. \$19.80. 79. 280.

Page 73.

80. 12 feet. 81. \$125. 82. $16\frac{1}{2}$ cents. 83. $4\frac{1}{2}$ quarts. 84. 10 cents.
 85. 20 cents. 86. 50 dozen. 87. $12\frac{3}{4}$ days; $1\frac{1}{2}$ days. 88. $7\frac{1}{2}$ cents;
 \$1. 89. $7\frac{1}{2}$ gallons. 90. 30 miles. 91. 21.

Page 74.

1. 63. 2. \$15,000. 3. \$80. 4. 20 cents a quart. 5. \$9.60.
 6. \$1.40 a bushel. 7. 200. 8. 800. 9. 24 cents. 10. \$5.40.
 11. \$20. 12. 24 cents. 13. \$252. 14. \$18.

Page 75.

15. 10. 16. $\frac{1}{2}$ of a bushel. 17. 12. 18. 10. 19. $34\frac{3}{4}$; $2\frac{3}{4}$.
 20. \$100. 21. Watch, \$90; chain, \$60. 22. $2\frac{1}{2}$ yards. 23. \$7.50.
 24. 60 years. 25. 60 miles. 26. \$1 $\frac{1}{2}$.

Page 76.

27. 9 cents a pound. 28. 20. 29. $5\frac{1}{2}$ hours. 30. $3\frac{1}{4}$ months.
 31. \$250. 32. 30 yards. 33. 64. 34. 12. 35. $1\frac{1}{4}$ days.
 36. 120 miles. 37. \$8.

Page 77.

38. 50 cents. 39. $3\frac{1}{4}$. 40. 60 cents. 41. \$50. 42. 69 miles.

Page 78.

21. 10. 22. 5. 23. \$3.20. 24. \$45. 25. \$17.25. 26. 39 miles.
 27. \$4 $\frac{1}{2}$.

Page 79.

28. 6 yards. 29. \$10 $\frac{1}{4}$. 30. 75 cents. 31. $2\frac{1}{4}$ miles.

Page 80.

26. \$1.60. 27. \$14. 28. 4 miles. 29. 30 miles. 30. \$5.
 1. \$30. 2. 90 miles. 3. 1 ton.

Page 81.

4. 10. 5. \$240. 6. \$2400. 7. 200 miles. 8. \$17,600. 9. \$3600.
 10. 45 years. 11. \$54. 12. \$2. 13. \$1200.

Page 82.

14. \$4.50. 15. 30 years. 16. 50 miles. 17. \$40. 18. Orange,
 2 $\frac{1}{2}$ cents; lemon, 2 cents. 19. 8 cents. 20. \$4 $\frac{1}{4}$.

Page 83.

2. \$31.50. 3. 20 cents. 4. 40 miles. 5. $\frac{1}{4}$.

Page 84.

6. \$75. 7. \$1000. 8. 11 tons. 9. \$26 $\frac{1}{2}$. 10. \$70. 11. \$8 $\frac{1}{2}$.
 12. $21\frac{1}{2}$ miles. 13. $6\frac{1}{2}$ cords. 14. $\frac{1}{4}$. 15. 8 days. 16. 20 days,
 17. 1 month.

Page 85.

18. $6\frac{1}{4}$ weeks. 19. $1\frac{1}{4}$ weeks. 20. \$ $\frac{2}{10}$. 21. John, \$48; James,
 \$45. 22. 150 miles. 23. $\frac{1}{4}$; $\frac{1}{3}$; $\frac{2}{3}$; 6 days; $1\frac{1}{4}$ days.

24. Since A can do a piece of work in 5 days, he can do $\frac{1}{5}$ of it in 1 day; and since B can do it in 6 days, he can do $\frac{1}{6}$ of it in 1 day.

Since A can do $\frac{1}{5}$ of a piece of work in 1 day, and B can do $\frac{1}{6}$ of it in 1 day, they can together do $\frac{1}{5} + \frac{1}{6}$, or $\frac{11}{30}$ of it in 1 day.

Since they together can do $\frac{11}{30}$ of the work in 1 day, they can do $\frac{30}{11}$ of it, or the whole work, in $\frac{30}{11}$ days, or $2\frac{8}{11}$ days.

25. Since A and B can do a piece of work in 4 days, they can do $\frac{1}{4}$ of the work in 1 day; and since A can do it in 6 days, he can do $\frac{1}{6}$ of it in 1 day.

Since A and B together can do $\frac{1}{4}$ of a piece of work in 1 day, and A can do $\frac{1}{6}$ of it in 1 day, B can do $\frac{1}{4} - \frac{1}{6}$, or $\frac{1}{12}$ of it in 1 day.

Since B can do $\frac{1}{12}$ of a piece of work in 1 day, he can do $\frac{12}{1}$, or the whole work, in 12 days.

26. $47\frac{1}{2}$ miles.

Page 86.

27. 28. 29. \$14. 30. \$6. 31. 7.

32. Since A can do a piece of work in 4 days, he can do $\frac{1}{4}$ of it in 1 day; and since B can do the work in 7 days, he can do $\frac{1}{7}$ of it in 1 day.

Since A can do $\frac{1}{4}$ of the work in 1 day, and B can do $\frac{1}{7}$ of it in 1 day, they can together do $\frac{1}{4} + \frac{1}{7}$, or $\frac{11}{28}$ of it in 1 day.

Since they can together do $\frac{11}{28}$ of it in 1 day, they can do $\frac{28}{11}$, or the whole work, in $\frac{28}{11}$ days, or $2\frac{6}{11}$ days.

33. Since A can do a piece of work in 2 days, he can do $\frac{1}{2}$ of it in 1 day; since B can do the work in 3 days, he can do $\frac{1}{3}$ of it in 1 day; and since C can do the work in 4 days, he can do $\frac{1}{4}$ of it in 1 day.

Since A can do $\frac{1}{2}$ of the work in 1 day, and B can do $\frac{1}{3}$ of it in 1 day, and C can do $\frac{1}{4}$ of it in 1 day, they can all together do $\frac{1}{2} + \frac{1}{3} + \frac{1}{4}$, or $\frac{13}{12}$ of it in 1 day.

Since they can all together do $\frac{13}{12}$ of the work in 1 day, they can do $\frac{12}{13}$, or the whole work, in $\frac{12}{13}$ of a day.

35. Since A can do a piece of work in $1\frac{1}{2}$ days, he can do $\frac{2}{3}$ of the work in 1 day; and since B can do the work in $2\frac{1}{2}$ days, he can do $\frac{2}{5}$ of it in 1 day. Both working together can, therefore, do $\frac{2}{3} + \frac{2}{5}$, or $\frac{16}{15}$ of the work in 1 day.

Since A does $\frac{2}{3}$, or $\frac{8}{12}$ of the work in 1 day, and together they do $\frac{16}{15}$ of the work in 1 day, A does $\frac{6}{15}$, or $\frac{2}{5}$ of the work done by both each day, and, consequently, he is entitled to $\frac{2}{5}$ of \$6, the sum earned, which is \$3 $\frac{1}{5}$. B's share is, therefore, $\frac{2}{5}$ of \$6, or \$2 $\frac{2}{5}$.

Page 87.

36. Since A can do a piece of work in $2\frac{1}{2}$ days, he can do $\frac{2}{5}$ of it in 1 day; and since B can do the work in $3\frac{1}{2}$ days, he can do $\frac{2}{7}$ of it in 1 day. Both working together can, therefore, do $\frac{2}{5} + \frac{2}{7}$, or $\frac{24}{35}$ of the work in 1 day.

Since A does $\frac{2}{5}$, or $\frac{24}{35}$ of the work in 1 day, and together they do $\frac{24}{35}$ of the work in 1 day, A does $\frac{24}{35}$ of the work done by both each day, and, consequently, he is entitled to $\frac{24}{35}$ of \$6.70, the sum earned, which is \$3.90. B's share is, therefore, $\frac{2}{7}$ of \$6.70, or \$2.80.

37. 6 days. 38. A, \$48; B, \$72. 39. 54.

40. Since Charles had $3\frac{1}{2}$ times as much money as James and spent $\frac{1}{2}$ of it, he then had $\frac{1}{2}$ of $3\frac{1}{2}$ times as much as James, or $\frac{7}{4}$ as much as James.

Before Charles earned \$5, they together had \$60 - \$5, or \$55; therefore, what James had plus $\frac{7}{4}$ of what he had, or $\frac{4}{4} + \frac{7}{4}$, or $\frac{11}{4}$ of what James had was \$55.

Since \$55 is $\frac{11}{4}$ of \$20, James had \$20; and since they both had \$60, Charles had \$60 less \$20, which is \$40.

41. 90. 42. 30 days. 43. A, \$100; B, \$80.

44. Since $\frac{1}{3}$ of \$150 = \$50, the three men were to receive \$120 for what they did.

Since they worked 2, 3, and 7 days respectively, it required in all $2 + 3 + 7$, or 12 days to do $\frac{1}{3}$ of the piece of work.

Since 2 days are $\frac{1}{6}$ of 12 days, the first should receive $\frac{1}{6}$ of \$120, or \$20; since 3 days are $\frac{1}{4}$ of 12 days, the second should receive $\frac{1}{4}$ of \$120, or \$30; and since 7 days are $\frac{7}{12}$ of 12 days, the third should receive $\frac{7}{12}$ of \$120, or \$70.

45. 120. 46. 220.

Page 88.

47. 69 miles.

48. Since B is $\frac{2}{3}$ as old as C, and A is $\frac{3}{4}$ as old as B, for every year in C's age, there is $\frac{2}{3}$ of a year in B's age, $\frac{2}{3}$ of $\frac{3}{4}$, or $\frac{1}{2}$ of a year in A's age, and $1 + \frac{2}{3} + \frac{1}{2}$, or $\frac{7}{6}$ of a year in the sum of their ages; that is, 108 years is $\frac{7}{6}$ of C's age; therefore, since 108 years is $\frac{7}{6}$ of 48 years, C is 48 years old; hence, B is $\frac{2}{3}$ of 48 years old, or 36 years old, and A is $\frac{3}{4}$ of 36 years old, or 27 years old.

49. 34 acres. 50. 45 cents.

51. Since B is to have $\frac{2}{3}$ as much money as C, and A is to have $\frac{1}{2}$ as much as B, for every dollar C is to have, B is to have $\frac{2}{3}$ of a dollar, A is to have $\frac{1}{2}$ of $\frac{2}{3}$, or $\frac{1}{3}$ of a dollar, and they are all to have $1 + \frac{2}{3} + \frac{1}{3}$, or $\frac{4}{3}$ of a dollar; therefore, C is to have as many dollars as $\frac{4}{3}$ is contained times in 740, or \$320; B is to have $\frac{2}{3}$ of \$320, or \$240; and A is to have $\frac{1}{2}$ of \$240, or \$180.

52. 210. 53. 57 miles. 54. The father, 49 years; the son, 21 years. 55. \$250. 56. \$120. 57. 30. 58. \$30,000.

Page 89.

59. Since $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$, the first boy and second boy together received $\frac{5}{6}$ of the money, and the third received $\frac{1}{6} - \frac{1}{6}$, or $\frac{1}{6}$ of it; therefore, the third boy received $\frac{1}{6} - \frac{1}{6}$, or $\frac{1}{6}$ of it more than the second; but he received \$60 more than the second; therefore, $\frac{1}{6}$ of the money was \$60, and the whole sum divided was 10 times \$60, or \$600.

Since the first boy received $\frac{1}{2}$ of the money, his share was $\frac{1}{2}$ of \$600, or \$300; similarly, the share of the second was $\frac{1}{3}$ of \$600, or \$200; and the share of the third was $\frac{1}{6}$ of \$600, or \$100.

60. Since the grocer gains 5 cents on a sale of 25 cents' worth of eggs, he gets 25 cents for the same number of eggs that cost him 20 cents; then, since 20 cents are $\frac{2}{3}$ of 30 cents, he buys $\frac{2}{3}$ of a dozen, or 8 eggs, for 20 cents; therefore, he sells 8 eggs for 25 cents.

61. 56 bushels. 62. $2\frac{1}{2}$ yards. 63. \$60.

64. Since A owned $\frac{1}{2}$ of the sheep, and B owned $\frac{1}{3}$ of them, they together owned $\frac{1}{2} + \frac{1}{3}$, or $\frac{5}{6}$ of them, and C owned $\frac{2}{6} - \frac{1}{6}$, or $\frac{1}{6}$ of them; therefore, C owned $\frac{1}{6} - \frac{1}{6}$, or $\frac{1}{6}$, or $\frac{1}{6}$ of them more than A and B together owned; but C owned 12 more than A and B together; therefore, $\frac{1}{6}$ of the number of sheep in the flock is 12, and the whole number in the flock is 10 times 12 sheep, or 120 sheep.

65. \$2. 66. \$25. 67. \$5 $\frac{1}{2}$. 68. 16 cents. 69. \$100.

Page 90.

70. 16 tons. 71. \$5. 72. One cow, \$42; the other, \$28. 73. 25. 74. 40 years. 75. 36. 76. \$60. 77. $7\frac{1}{2}$ hours.

78. Since the first pipe can empty the cistern in 2 hours, it can empty $\frac{1}{2}$ of it in 1 hour; and since the other pipe can fill the cistern in 3 hours, it can fill $\frac{1}{3}$ of it in 1 hour; if the cistern is full and both

pipes are set running, it will be emptied at the rate of $\frac{1}{2} - \frac{1}{3}$, or $\frac{1}{6}$ of it in 1 hour; hence, it will be emptied in 6 hours.

79. \$30. 80. 12.

Page 91.

81. Henry, 42; William, 30.

82. Since a stick $3\frac{1}{2}$ feet long will cast a shadow $4\frac{1}{2}$ feet long; and since 6 feet are $\frac{1}{2}$ of $3\frac{1}{2}$ feet, a stick 6 feet long will cast a shadow $\frac{1}{2}$ of $4\frac{1}{2}$ feet, or 8 feet long.

83. 150. 84. 10 days. 85. Sleigh, \$80; horse, \$280. 86. \$4 $\frac{1}{2}$.
87. 105. 88. 72. 89. \$1.14. 90. \$150.

Page 92.

91. \$24. 92. \$150. 93. 5 yards. 94. $4\frac{1}{2}$ miles. 95. 16.
96. \$150.

97. Since bread is sold at 6 cents a loaf when flour is \$6 $\frac{1}{2}$ a barrel, and since \$8 $\frac{1}{2}$ are $\frac{1}{2}$ of \$6 $\frac{1}{2}$, $\frac{1}{2}$ of 6 cents, or 3 cents should be charged for a loaf when flour is \$8 $\frac{1}{2}$ per barrel.

98. Since it requires 1 cut to saw a stick of wood into 2 pieces, and 2 cuts to saw a stick into 3 pieces, it requires twice as much work to saw wood into 3 pieces as it does to saw it into 2 pieces; therefore, if \$3 is paid for sawing some wood, each stick into 2 pieces, 2 times \$3, or \$6 should be paid for sawing the wood, each stick into 3 pieces.

99. 40. 100. 40 years. 101. 100.

Page 93.

102. \$56. 103. 15. 104. \$25. 105. \$1.20. 106. \$9.60.
107. 90. 108. \$100. 109. 3 days. 110. 6. 111. \$8.
112. 100. 113. $7\frac{1}{2}$.

Page 94.

114. \$36.

115. Since the piece left standing was $\frac{2}{3}$ as long as the middle piece, and $\frac{2}{3}$ as long as the end piece, $\frac{2}{3}$ of the middle piece equals $\frac{2}{3}$ of the end piece; therefore, $\frac{1}{3}$ of the middle piece equals $\frac{1}{3}$ of the end piece, and $\frac{1}{3}$ of the middle piece equals $\frac{1}{3}$ of the end piece; hence, the sum of the middle piece and the end piece equals $\frac{4}{3}$ of the end piece plus $\frac{1}{3}$ of

the end piece, or $\frac{1}{3}$ of the end piece ; but this sum equals 84 feet ; that is, $\frac{1}{3}$ of the end piece is 84 feet, and $\frac{1}{3}$ of it is 7 feet.

Since the piece left standing is $\frac{2}{3}$ as long as the end piece, it is 2 times 7 feet, or 14 feet long.

116. 100 miles.

117. Since 5 bushels of wheat cost \$ $1\frac{1}{2}$, or \$ $\frac{3}{2}$, more than 5 bushels of corn, 1 bushel of wheat costs \$ $\frac{1}{5}$, or 25 cents, more than 1 bushel of corn.

Since a bushel of wheat costs 25 cents more than a bushel of corn, and 2 bushels, one of each, cost \$ 1, or 100 cents, the difference between 100 cents and 25 cents, or 75 cents, is twice the cost of a bushel of corn ; therefore, a bushel of corn costs $\frac{1}{2}$ of 75 cents, or $37\frac{1}{2}$ cents ; hence, a bushel of wheat costs $37\frac{1}{2}$ cents plus 25 cents, or $62\frac{1}{2}$ cents.

118. Since $\frac{2}{3}$ of the number of boys equals $\frac{3}{4}$ of the number of girls, $\frac{1}{3}$ of the number of boys equals $\frac{1}{4}$ of $\frac{3}{2}$, or $\frac{1}{3}$ of the number of girls, and $\frac{1}{3}$, or the whole number of boys, equals 3 times $\frac{1}{3}$, or $\frac{1}{3}$ of the number of girls ; therefore, the whole number of boys plus the whole number of girls, or the whole number of pupils, equals $\frac{4}{3}$ of the number of girls plus $\frac{1}{3}$ of the number of girls, or $\frac{5}{3}$ of the number of girls ; that is, 850 is $\frac{5}{3}$ of the number of girls.

Since 850 is $\frac{5}{3}$ of 400, there are 400 girls in the school ; consequently, there are $850 - 400$, or 450 boys in the school.

119. Since I had 80 cents left after expending 10 cents more than $\frac{2}{3}$ of my money, I would have had 90 cents left if I had spent only $\frac{2}{3}$ of my money ; therefore, 90 cents is $\frac{2}{3}$ of the money I had at first.

Since 90 cents is $\frac{2}{3}$ of 150 cents, or \$ 1.50, I had \$ 1.50 at first.

Page 95.

3. \$ 33. 4. \$ 12. 5. \$ 30. 6. \$ 9 ; \$ 16. 7. \$ 49. 8. \$ 6 ; \$ 32.
9. \$ 45.

Page 97.

53. \$ 450. 54. \$ 330. 55. \$ 120. 56. \$ 80. 57. \$ 80. 58. \$ 420.
59. \$ 60. 60. \$ 90. 61. \$ 600. 62. \$ 2500. 63. \$ 2800.

Page 98.

69. \$ 900. 70. \$ 910. 71. \$ 660. 72. \$ 360. 73. \$ 603.75.
74. \$ 450. 75. 15 ; 21 ; 9 ; 19. 76. 71,500.

Page 99.

77. 38,000; 39,000; 67,500; 93,500. 78. \$3900. 79. \$18,000.
 80. \$30,000. 81. \$6300. 82. 6000 miles. 83. 3625. 84. \$1760.
 85. \$465.
 1. 12. 2. 24. 3. 6; 9; 15; 27. 4. 80 cords.

Page 100.

5. 40. 6. 16 days. 7. 5½. 8. 80. 9. 32. 10. 64 weeks.
 11. 16 days. 12. 3600 tons. 13. 24. 14. 24 hours. 15. 80. 16. 640.

Page 101.

17. 16. 18. 40; 48; 80. 19. 56. 20. 32. 21. 80. 22. 32.
 23. 16. 24. 240; 240; 56. 25. 48. 26. 16 months. 27. 40.
 28. 80. 29. 32.

Page 102.

1. First, \$44; second, \$28. 2. First, 30; second, 18. 3. Sheep,
 \$50; pigs, \$80. 4. 15; first, 45 miles; second, 75 miles. 5. 80, 60.
 6. First, \$21; second, \$16.50. 7. A, \$17.50; B, \$12.50. 8. 80.
 9. First, \$8; second, \$13.

Page 103.

10. Since 2 horses eat as much as 3 cows, 8 horses eat as much as 4 times 3 cows, or 12 cows, and the 8 horses and 14 cows eat as much as 12 + 14, or 26 cows; consequently, the pasturage of the horses was $\frac{12}{26}$, or $\frac{6}{13}$ of the whole pasturage, and that of the cows $\frac{14}{26}$, or $\frac{7}{13}$ of the whole pasturage; therefore, the pasturage of the horses cost $\frac{6}{13}$ of \$52, or \$24, and that of the cows $\frac{7}{13}$ of \$52, or \$28.

11. In every 16 units of the sum of the required numbers, 7 of them belong to the first number and 9 of them to the second; therefore, the first number is $\frac{7}{16}$ of the sum, and the second is $\frac{9}{16}$ of the sum; that is, the first is $\frac{7}{16}$ of 80, or 35, and the second is $\frac{9}{16}$ of 80, or 45.

12. Since 3 boys can do as much as 2 men, and since 12 boys are 4 times 3 boys, 12 boys can do as much as 4 times 2 men, or 8 men; therefore, B sends the equivalent of 8 men.

Since A sends 5 men, and B the equivalent of 8 men, A and B together send the equivalent of 5 men + 8 men, or 13 men; conse-

quently, A should receive $\frac{1}{3}$ of the pay for the work and B should receive $\frac{2}{3}$ of it; that is, A should receive $\frac{1}{3}$ of \$130, or \$50, and B should receive $\frac{2}{3}$ of \$130, or \$80.

13. First, \$48; second, \$60. 14. First, 200; second, 150; third, 250. 15. First, \$150; second, \$200; third, \$300.

16. Since 2 men can do as much as 5 boys, 4 men can do as much as 10 boys; therefore, the 4 men and 7 boys do as much as $10 + 7$, or 17 boys; hence, the men do $\frac{10}{17}$ of the work and the boys $\frac{7}{17}$ of it; consequently, the men receive $\frac{10}{17}$ of \$68, or \$40, and the boys receive $\frac{7}{17}$ of \$68, or \$28.

Since 4 men receive \$40 for working 4 days, each man receives $\frac{1}{4}$ of \$40, or \$10, for working 4 days; consequently, each man receives $\frac{1}{4}$ of \$10, or \$2 $\frac{1}{2}$ per day.

Since 7 boys receive \$28 for working 4 days, each boy receives $\frac{1}{7}$ of \$28, or \$4, for working 4 days; consequently, each boy receives $\frac{1}{7}$ of \$4, or \$1 per day.

17. A, \$40; B, \$100; C, \$140. 18. First, 12; second, 15; third, 21.

Page 104.

19. Since 3 oranges cost as much as 5 apples, an orange costs $\frac{5}{3}$ as much as an apple, and 12 oranges cost as much as $\frac{5}{3}$ of 12 apples, or 20 apples; therefore, a dozen oranges and a dozen apples cost as much as 20 apples + 12 apples, or 32 apples; but a dozen oranges and a dozen apples cost 96 cents; therefore, 32 apples cost 96 cents and 1 apple costs $\frac{1}{32}$ of 96 cents, or 3 cents.

Since an orange costs $\frac{5}{3}$ as much as an apple, it costs $\frac{1}{3}$ of 3 cents, or 5 cents.

20. One man, \$90; the other, \$60.

21. Since 2 horses eat as much as 3 cows, 4 horses will eat as much as 6 cows; since 1 cow eats as much as 7 sheep, 21 sheep will eat as much as 3 cows.

Hence, the 4 horses, 9 cows, and 21 sheep will eat as much as 6 cows, 9 cows, and 3 cows, or 18 cows; therefore, the 4 horses will eat $\frac{6}{18}$, or $\frac{1}{3}$ of what they all eat; the 9 cows, $\frac{9}{18}$, or $\frac{1}{2}$; and the 21 sheep, $\frac{3}{18}$, or $\frac{1}{6}$.

Consequently, A should pay $\frac{1}{3}$ of the rent, or $\frac{1}{3}$ of \$72, or \$24; B, $\frac{1}{2}$ of \$72, or \$36; and C, $\frac{1}{6}$ of \$72, or \$12.

22. First, \$500; second, \$350.

2. Since by giving each child 10 cents, he would have given each 5 cents more than he did, and since by so doing he would have given them in all 50 cents more than he did, there were as many children as 5 is contained times in 50, or 10 children.

3. Since by paying \$5 each for calves the man had left \$40 more than he would have had left if he had bought an equal number of hogs at \$2 more a head, he must have bought as many calves as \$2, the saving on each animal, is contained times in \$40, the saving on all; therefore, he bought 20 calves.

Page 105.

4. Since by expending 20 cents for each pupil instead of 15 cents, the cost for each would have been increased 5 cents, and since the total cost would have been increased \$2 - \$1, or \$1, or 100 cents, there must have been as many pupils as 5 cents is contained times in 100 cents, or 20 pupils.

5. Since paying 5 cents each instead of 3 cents each for oranges would make a difference of 2 cents each in the cost, and since this would have made a total difference of 24 cents in the cost of the number I bought, I bought as many oranges as 2 cents is contained times in 24 cents, or 12 oranges.

6. Since by paying 25 cents a yard for ribbon instead of 15 cents, the lady would have paid 10 cents more for each yard, and since by so doing the total difference in the cost of the quantity she bought would have been 50 cents + 50 cents, or 100 cents, she bought as many yards as 10 cents is contained times in 100 cents, or 10 yards; therefore, she had 10 times 15 cents, plus \$.50, or \$2.00.

7. Since he gave each boy 4 tickets and each girl 5 tickets, he gave 9 tickets for every two children that there were; therefore, there were as many times two children as 9 is contained times in 45, the whole number of tickets he gave away, or 5 times 2 children, or 10 children.

8. Since the farmer received \$4 for each sheep and \$6 for each pig, for every \$10 he received he sold a sheep and a pig; therefore, he sold as many of each as \$10 is contained times in \$100, or 10 of each.

9. Since the first man is paid \$1½ a day and the second \$2½ a day, both are paid the sum of \$1½ and \$2½, or \$4 a day, and since \$1½ is ¾ of \$4 and \$2½ is ⅝ of \$4, the first should receive ¾ of their combined earnings and the second ⅝ of their combined earnings.

Therefore, the first should receive $\frac{1}{3}$ of \$60, or \$22 $\frac{1}{3}$, and the second should receive $\frac{2}{3}$ of \$60, or \$37 $\frac{1}{3}$.

10. Since by paying \$50 a head instead of \$40 the cost of each is \$10 more, and the total cost is increased \$20 + \$100, or \$120, there were as many head of cattle as \$10 is contained times in \$120, or 12 head of cattle.

11. Since for every 3 cents paid for lemons there were 2 times 4 cents, or 8 cents, paid for oranges, there were 11 cents paid out for both for each lemon that was bought; therefore, there were as many lemons bought as 11 cents is contained times in 110 cents, or 10 lemons.

Since there were 10 lemons and twice as many oranges, there were 2 times 10, or 20 oranges.

Page 106.

1. $\frac{1}{3}$; $\frac{2}{3}$.

2. Since A, B, and C can dig a trench in $2\frac{1}{2}$ days, or $\frac{5}{2}$ days, they can dig $\frac{2}{5}$ of it in 1 day; and since B and C can do the work in $4\frac{1}{2}$ days, or $\frac{9}{2}$ days, they can do $\frac{2}{9}$ of it in 1 day.

Since A, B, and C can do $\frac{2}{5}$ of the work in 1 day, and B and C can do $\frac{2}{9}$ of it in 1 day, A can do $\frac{2}{5} - \frac{2}{9}$, or $\frac{8}{45}$ of it in 1 day.

Since A can do $\frac{8}{45}$ of the work in 1 day, he can do $\frac{45}{8}$ of the work, or the whole work, in 6 days.

Since B can do the work in 8 days, he can do $\frac{1}{8}$ of it in 1 day; and since B and C can do $\frac{2}{9}$ of the work in 1 day, C can do $\frac{2}{9} - \frac{1}{8}$, or $\frac{7}{72}$ of it in 1 day.

Since C can do $\frac{7}{72}$ of the work in 1 day, he can do $\frac{72}{7}$ of the work, or the whole work, in 12 days.

3. Since 3 men can do as much as 5 boys, 2 times 3 men, or 6 men, can do as much as 10 boys; therefore, 5 men and 10 boys can do the same amount of work as 5 men and 6 men, or 11 men.

Since 5 men can do a piece of work in 6 days, 1 man can do it in 5 times 6 days, or 30 days, and 11 men can do it in $\frac{1}{11}$ of 30 days, or $2\frac{8}{11}$ days.

Since 5 men and 10 boys can do as much as 11 men, it will take 5 men and 10 boys $2\frac{8}{11}$ days to do the work.

4. Since A can plow a field in 4 days, he can plow $\frac{1}{4}$ of it in 1 day; and since B can plow the field in 6 days, he can plow $\frac{1}{6}$ of it in 1 day, or $\frac{1}{12}$ of it in half a day.

Since B works half as long as A, he works half a day for every day A works; therefore, for every day A works, $\frac{1}{2}$ of the field + $\frac{1}{2}$ of the field, or $\frac{3}{2}$ of the field will be plowed; hence, it will require 3 days for them to plow the whole field, if B works half of the time.

5. Since A can do $\frac{1}{2}$ of the work while B does $\frac{2}{3}$ of it, A can do $\frac{1}{2}$ of it while both working together can do $\frac{1}{2} + \frac{2}{3}$, or $\frac{7}{6}$ of it; and since $\frac{1}{2}$ is $\frac{3}{7}$ of $\frac{7}{6}$, A can do $\frac{3}{7}$ of what they can do together; consequently, B can do $\frac{4}{7} - \frac{3}{7}$, or $\frac{1}{7}$ of what they can do together.

Since they can together mow the field in $3\frac{3}{7}$ days, or $\frac{24}{7}$ days, they can mow $\frac{7}{24}$ of it in 1 day; hence, A can mow $\frac{3}{7}$ of $\frac{7}{24}$, or $\frac{1}{8}$ of it in 1 day; and B can mow $\frac{1}{7}$ of $\frac{7}{24}$, or $\frac{1}{24}$ of it in 1 day.

Since A can mow $\frac{1}{8}$ of the field in 1 day, he can mow $\frac{8}{8}$ of it, or the whole field, in 8 days; and since B can mow $\frac{1}{24}$ of the field in one day, he can mow $\frac{24}{24}$ of it, or the whole field, in 24 days.

6. Since A can make a coat in 3 days, in 1 day he can do $\frac{1}{3}$ of the work necessary to make a coat; and since B can make 4 coats in 10 days, in 1 day he can do $\frac{4}{10}$, or $\frac{2}{5}$ of the work necessary to make a coat; therefore, in 1 day working together, they can do $\frac{1}{3} + \frac{2}{5}$, or $\frac{7}{15}$ of the work necessary to make a coat.

Since it requires 1 day for both to do $\frac{7}{15}$ of the work necessary to make a coat, it will require as many days for them to do the work necessary to make 11 coats as $\frac{7}{15}$ is contained times in 11, or 15 days.

7. Since A and B can build a wall in 3 days, they can build $\frac{1}{3}$ of it in 1 day; since A and C can build the wall in 6 days, they can build $\frac{1}{6}$ of it in 1 day; and since B and C can build the wall in $2\frac{2}{3}$ days, or $\frac{8}{3}$ days, they can build $\frac{3}{8}$ of it in 1 day; hence, twice what A, B, and C together can do in 1 day is $\frac{1}{3} + \frac{1}{6} + \frac{3}{8}$, or $\frac{11}{8}$ of the work; consequently, A, B, and C together can do $\frac{1}{2}$ of $\frac{11}{8}$, or $\frac{11}{16}$ of the work in 1 day.

Since A, B, and C can do $\frac{11}{16}$ of the work in 1 day, and B and C can do $\frac{5}{8}$ of it in 1 day, A can do $\frac{11}{16} - \frac{5}{8}$, or $\frac{1}{4}$ of it in 1 day; therefore, he can do the whole work in 4 days; similarly, B can do $\frac{11}{16} - \frac{1}{4}$, or $\frac{9}{16}$ of it in 1 day; therefore, he can do the whole work in $1\frac{7}{9}$ days, or $2\frac{1}{9}$ days; also C can do $\frac{11}{16} - \frac{1}{4}$, or $\frac{3}{8}$ of it in 1 day; therefore, he can do the whole work in 8 days.

Since A, B, and C can, all together, do $\frac{11}{16}$ of the work in 1 day, they can do the whole work in $1\frac{7}{9}$ days, or $2\frac{1}{9}$ days.

8. Since A and B can do a piece of work in 4 days, they can do $\frac{1}{4}$ of it in 1 day; since A and C can do the work in 6 days, they can do

$\frac{1}{2}$ of it in 1 day; and since B and C can do the work in 8 days, they can do $\frac{1}{8}$ of it in 1 day; hence, twice what A, B, and C together can do in 1 day is $\frac{1}{2} + \frac{1}{8} + \frac{1}{8}$, or $\frac{3}{4}$ of the work; consequently, A, B, and C together can do $\frac{1}{3}$ of $\frac{3}{4}$, or $\frac{1}{4}$ of the work in 1 day.

Since A, B, and C can do $\frac{1}{4}$ of the work in 1 day, and B and C can do $\frac{1}{8}$ of it in 1 day, A can do $\frac{1}{4} - \frac{1}{8}$, or $\frac{1}{8}$ of it in 1 day; therefore, he can do the whole work in $4\frac{1}{2}$ days, or $6\frac{1}{2}$ days; similarly, B can do $\frac{1}{4} - \frac{1}{8}$, or $\frac{1}{8}$ of it in 1 day; therefore, he can do the whole work in $4\frac{1}{2}$ days, or $9\frac{1}{2}$ days; also, C can do $\frac{1}{4} - \frac{1}{8}$, or $\frac{1}{8}$ of it in 1 day; therefore, he can do the whole work in 48 days.

9. Since A and B can row a distance in 4 hours, they can row $\frac{1}{4}$ of the distance in 1 hour; and since B can row it alone in 9 hours, he can row $\frac{1}{9}$ of it in 1 hour; hence, A can row $\frac{1}{4} - \frac{1}{9}$, or $\frac{5}{36}$ of the distance in 1 hour.

Since A and B can together row $\frac{1}{4}$ of the distance in 1 hour, they can row 3 times $\frac{1}{4}$, or $\frac{3}{4}$ of the distance in 3 hours; consequently, after they have rowed together 3 hours, there is left $\frac{1}{4} - \frac{3}{4}$, or $\frac{1}{4}$ of the distance for A to row alone.

Since A has $\frac{1}{4}$ of the distance to row, and can row $\frac{5}{36}$ of the distance in 1 hour, it will take him as many hours to finish as $\frac{1}{4}$ is contained times in $\frac{1}{4}$, or $1\frac{1}{5}$ hours.

Page 107.

2. First, 26; second, 17. 3. 19; 31. 4. Harry, 65 cents; his brother, 35 cents. 5. Wheat, 80 cents; rye, 60 cents. 6. 30.

7. Since the farmers at first had the same number of sheep, after one sold 25 and the other 35, the first had 10 more than the second, and together they had left 100.

Since the first had 10 more left than the second, the sum of what both had left, or 100, is 10 more than twice the number the second had left. Hence, $100 - 10$, or 90 is twice the number of sheep the second had left; therefore, the second had left $\frac{1}{2}$ of 90 sheep, or 45 sheep; and since he had 45 left after selling 35, he had at first the sum of 45 sheep and 35 sheep, or 80 sheep; therefore, each had 80 sheep at first.

8. Since the bicycles cost the same, and one boy sold his for \$10 less than cost, while the other boy sold his for \$8 less than cost, the second boy received \$2 more for his bicycle than the first received.

Since the second boy received \$2 more than the first, the sum of

what both received, or \$62, is \$2 more than twice what the first received. Hence, \$62 - \$2, or \$60, is twice what the first boy received for his bicycle; therefore, the first boy received $\frac{1}{2}$ of \$60, or \$30; and since he sold his bicycle for \$10 less than cost, he paid \$30 + \$10, or \$40 for it; consequently, the second boy paid \$40 for his bicycle.

9. Since $\frac{1}{2}$ of the sum of two numbers is 39, the sum of the numbers is 2 times 39, or 78; and since $\frac{1}{2}$ of the difference of two numbers is 6, the difference of the numbers is 3 times 6, or 18.

Since one number is 18 more than the other, their sum, 78, is 18 more than twice the less number. Hence, 78 - 18, or 60, is twice the less number; therefore, $\frac{1}{2}$ of 60, or 30, is the less number, and 78 - 30, or 48, is the greater number.

10. 27.

Page 106.

11. 36. 12. A, 47; B, 56.

13. Since Mr. Brown's age is twice his son's age and 8 years more, the difference between his age and his son's age is once his son's age increased by 8 years; but this difference is 22 years; therefore, the son's age increased by 8 years equals 22 years; hence, the son's age is 8 years less than 22 years, or 14 years; consequently, Mr. Brown's age is the sum of 2 times 14 years, or 28 years, plus 8 years, which is 36 years.

14. Since, after paying \$18 more than $\frac{2}{3}$ of my money for an overcoat, I have $\frac{1}{3}$ of it left, if I had paid only \$18 for it, I would have had $\frac{2}{3} + \frac{1}{3}$, or $\frac{4}{3}$ of it left; therefore, \$18 is $\frac{4}{3} - \frac{2}{3}$, or $\frac{2}{3}$ of my money.

Since \$18 is $\frac{2}{3}$ of \$80, I had \$80; therefore, $\frac{2}{3}$ of my money is $\frac{2}{3}$ of \$80, or \$32, and the overcoat cost \$32 + \$18, or \$50.

15. Since after selling 20 acres less than $\frac{1}{4}$ of his land, the farmer received \$4000 for the remainder at \$50 per acre, he had as many acres left as \$50 is contained times in \$4000, or 80 acres.

Since, after selling 20 acres less than $\frac{1}{4}$ of his land he had 80 acres left, if he had sold $\frac{1}{4}$ of his land, he would have had left 80 - 20, or 60 acres; but he would have had left $\frac{3}{4}$ of his land; therefore, $\frac{3}{4}$ of his land is 60 acres.

Since 60 is $\frac{3}{4}$ of 160, he had 160 acres at first.

16. Since A has $2\frac{1}{2}$ times as many sheep as B, if he sells 25 of his sheep to B, A will then have $2\frac{1}{2}$ times B's original number less 25 sheep, and B will have 25 more than his original number; but since each will

then have the same number of sheep, $2\frac{1}{2}$ times B's original number less 25 is equal to 25 more than B's original number; therefore, $2\frac{1}{2}$ times B's original number is equal to 50 more than his original number; consequently, $1\frac{1}{2}$ times B's original number, or $\frac{3}{4}$ of the number B had at first equals 50; and since 50 is $\frac{5}{4}$ of 40, B had 40 sheep originally; consequently, A had originally $2\frac{1}{2}$ times 40 sheep, or 90 sheep.

17. Since in 3 years the sum of Mary's age and her mother's age will be 50 years; and since each will be 3 years older than she is now, the sum of their ages now is $50 - 6$, or 44 years.

Since Mary's age is $\frac{2}{3}$ of her mother's age, the sum of their ages is $\frac{2}{3} + \frac{3}{3}$, or $1\frac{1}{3}$ of her mother's age.

Therefore, $1\frac{1}{3}$ of her mother's age is 44 years; and since 44 is $1\frac{1}{3}$ of 32, Mary's mother is 32 years old.

Since Mary is $\frac{2}{3}$ as old as her mother, she is $\frac{2}{3}$ of 32 years old, or 12 years old.

18. Since after sailing downstream a certain distance the boat sailed upstream 12 miles more than $\frac{2}{3}$ of the distance it sailed downstream, it sailed in all 12 miles more than $\frac{2}{3} + \frac{1}{3}$, or $\frac{3}{3}$ of the distance it sailed downstream; but the entire distance it sailed was 20 miles; hence, 12 miles more than $\frac{2}{3}$ of the distance it sailed downstream is 20 miles; therefore, $\frac{2}{3}$ of the distance it sailed downstream is $20 - 12$, or 8 miles.

Since 8 is $\frac{2}{3}$ of 5, the boat sailed downstream 5 miles.

19. 32.

20. Since $\frac{1}{4}$ the cost of the coat, plus \$2, equals the cost of the vest, both cost $\frac{1}{4}$ the cost of the coat plus $\frac{1}{4}$ the cost of the coat plus \$2, or $\frac{2}{4}$ the cost of the coat plus \$2; but both cost \$27; therefore, $\frac{2}{4}$ the cost of the coat plus \$2 is \$27; hence, $\frac{2}{4}$ the cost of the coat is \$27 - \$2, or \$25.

Since \$25 is $\frac{5}{4}$ of \$20, the coat cost \$20; therefore, the vest cost $\frac{1}{4}$ of \$20, plus \$2, or \$5 + \$2, or \$7.

DENOMINATE NUMBERS.

Page 109.

7. \$1.20. 8. 67 $\frac{1}{2}$ cents. 9. \$10.

Page 110.

10. \$1.20. 11. 1600. 12. 67 $\frac{1}{2}$ cents. 13. 2 min. 16 sec.
 14. \$1.06. 15. 120. 16. \$12.
 4. 150. 5. 8.

Page 111.

6. \$3.60. 7. \$3.60. 8. \$4. 9. 10. 10. \$12. 11. \$9.
12. 8 rd. 13. 5. 14. 80. 15. 20 sq. yd. ; 12 sq. ft.

Page 112.

3. \$2.43. 4. 4. 5. \$90. 6. 6 ft. 7. 4. 8. 192. 9. 600
cu. ft. 10. Each, 20 yd. 11. 3000.

Page 113.

12. 1728. 13. 64. 14. 6250 lb. 15. \$12. 16. 6 ft.
6. 25 gal. 7. \$8.

Page 114.

8. \$6. 9. 45 cents ; \$1.05. 10. \$3.20. 11. 3 pt. 12. 8.
13. 2 qt.
3. \$1 $\frac{1}{2}$. 4. 35 cents. 5. 26 $\frac{1}{2}$ days. 6. \$2.40.

Page 115.

7. 10. 8. \$1.42. 9. $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{6}$. 10. \$2.88. 11. \$15.
12. 90 cents. 13. \$1.20. 14. \$3 $\frac{1}{2}$.

Page 116.

8. \$4.60. 9. 8 oz. 10. 87 cents. 12. \$19. 13. 900 lb.
14. 41 cents.
5. \$144.

Page 117.

6. \$25. 7. \$240. 8. \$400. 9. $\frac{1}{10}$; $\frac{1}{2}$. 10. 3 $\frac{1}{2}$ oz. 11. 96
cents ; \$19.20.

Page 118.

7. 45 mi. 8. 13 $\frac{1}{2}$ hr. 9. 9 hr. 40 min. ; 14 hr. 20 min.
10. 1860, 1868. 11. Dec., Jan., Feb. ; June, July, Aug. 12. 94
days ; in the northern hemisphere, astronomically, 4 days ; popularly,
24 days. 13. 91. 14. 3 mi. 15. 2 min. 40 sec. 16. From 1896
to 1904. 17. 10 hr. 10 min. 18. Sunday ; Monday.

Page 119.

8. £9. 9. £2 $\frac{1}{2}$. 10. £1. 11. $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{6}$. 12. About \$4.80
13. 20. 14. 34 s. ; about \$8.16.

Page 120.

1. \$2.50. 2. 70. 3. \$2. 4. 120. 5. 5 ft. 6. 42 cents.
 7. \$1.36. 8. \$2.50. 9. 80 cents. 10. 30 hr. 11. \$2.40.
 12. $2\frac{1}{2}$; $3\frac{1}{2}$; $4\frac{1}{2}$. 13. \$1.14. 14. \$2.25.

Page 121.

15. \$2. 16. \$14.40. 17. \$1.80; \$2.25. 18. 10.
 1. \$1.50. 2. \$1.45. 3. 34 cents. 4. \$120. 5. 13.
 6. \$46. 7. 75. 8. 65. 9. \$75.

Page 122.

10. \$3.20. 11. 50 mi. 12. 32 cents. 13. \$60. 14. $73\frac{1}{2}$ ft.
 15. 56 cents. 16. 32. 17. \$60. 18. \$1.20. 19. 80 cents.
 20. \$41. 21. $4\frac{1}{2}$ yd. 22. \$5.80.

Page 123.

23. 40 mi. 24. 15 sq. ft. 25. 1760. 26. 7 mo. 6 da.; 4 mo.
 15 da. 27. $\frac{1}{2}$; $\frac{1}{3}$; $\frac{1}{4}$. 28. 3. 29. \$1.50. 30. 10. 31.
 \$5.40. 32. $62\frac{1}{2}$. 33. \$4. 34. 28 cents. 35. \$22.50.

Page 124.

36. 5 hr. 37. \$1. 38. $2\frac{1}{2}$ yd. 39. 120 rd. 40. 3000.
 41. 35 min. 42. 90. 43. \$2. 44. 1 gal. 1 qt. 1 pt. 45. 160.
 46. 60 gal. 1 qt. 1 pt. 47. 16.

PERCENTAGE.

Page 126.

12. \$20. 13. 30. 14. \$2. 15. \$90. 16. \$1000.
 17. \$750. 18. \$360. 19. \$30 better to sell \$3000 worth at 5%
 profit. 20. \$105.

Page 127.

4. $37\frac{1}{2}\%$; $62\frac{1}{2}\%$. 5. Hat, $16\frac{1}{2}\%$; overcoat, $83\frac{1}{2}\%$. 6. 60% sold;
 20% reserved.

Page 128.

13. 80%. 14. 50%. 15. 25% due to current; 75% due to rowing.
 16. \$150; 33 $\frac{1}{3}$ %. 17. 66 $\frac{2}{3}$ %. 18. 25%; \$120. 19. 33 $\frac{1}{3}$ %. 20. 50%.
 21. 100%. 22. 32%.

Page 129.

2. \$8 per ton. 3. \$80. 4. 320. 5. 31 $\frac{1}{2}$. 6. \$120.

7. Since B sold a horse to C at a gain of 10%, or $\frac{1}{10}$ of the cost, the selling price was $\frac{11}{10}$ of the cost; that is, \$198 is $\frac{11}{10}$ of what the horse cost B; but \$198 is $\frac{11}{10}$ of \$180; therefore, the horse cost B \$180.

Since A sold the horse to B at a gain of 20%, or $\frac{1}{5}$ of the cost, the selling price was $\frac{6}{5}$ of the cost; that is, \$180 is $\frac{6}{5}$ of what the horse cost A; but \$180 is $\frac{6}{5}$ of \$150; therefore, the horse cost A \$150.

8. \$500.

9. Since the merchant diminished his gain 20%, or $\frac{1}{5}$ by reducing the price of ribbon from 40 cents to 35 cents a yard, 5 cents is $\frac{1}{5}$ of his gain when he sold ribbon at 40 cents a yard; therefore, 5 times 5 cents, or 25 cents, was his gain when he sold ribbon at 40 cents a yard; hence, the ribbon cost him 40 cents less 25 cents, or 15 cents a yard.

10. Since by raising the price of coal 60 cents per ton, the coal merchant gained 50% instead of 33 $\frac{1}{3}$ %, 60 cents is 50% - 33 $\frac{1}{3}$ %, or 16 $\frac{2}{3}$ %, or $\frac{1}{3}$ of the cost of a ton; therefore, the cost of the coal per ton was 6 times 60 cents, or 360 cents, or \$3.60.

Page 130.

11. 800.

12. Since the merchant lost 16 $\frac{2}{3}$ %, or $\frac{1}{3}$ of the cost, he sold the cloth for $\frac{2}{3}$ of the cost; that is, \$2 $\frac{1}{3}$ is $\frac{2}{3}$ of the cost of the cloth per yard; and since \$2 $\frac{1}{3}$ is $\frac{2}{3}$ of \$3, the cloth cost \$3 per yard.

Since the cloth cost \$3 per yard, in order to gain 16 $\frac{2}{3}$ %, or $\frac{1}{3}$ of the cost he must sell it for $\frac{4}{3}$ of \$3, or \$3 $\frac{1}{3}$ per yard.

13. Since if my expenses were increased 12 $\frac{1}{2}$ %, my monthly savings would be \$21 less than they are, \$21 is 12 $\frac{1}{2}$ %, or $\frac{1}{8}$ of my monthly savings; therefore, since \$21 is $\frac{1}{8}$ of \$168, I save \$168 a month.

Since I save 75%, or $\frac{3}{4}$ as much as I spend, \$168 is $\frac{3}{4}$ of what I spend a month; therefore, since \$168 is $\frac{3}{4}$ of \$224, I spend \$224 a month.

Since I save \$168 a month and spend \$224 a month, I get \$168 + \$224, or \$392 a month.

14. Since \$60 is 20%, or $\frac{1}{5}$ less than the value of the watch, \$60 is $\frac{4}{5}$ of its value; and since \$60 is $\frac{4}{5}$ of \$75, the value of the watch is \$75.

Since the man sold the watch for 20%, or $\frac{1}{5}$ more than its value, he sold it for $\frac{6}{5}$ of its value, which is $\frac{6}{5}$ of \$75, or \$90.

Since he paid \$60 for the watch and sold it for \$90, he gained the difference between \$90 and \$60, or \$30; and since \$30 is $\frac{1}{2}$ of \$60, \$30 is $\frac{1}{100}$, or 50% of \$60; therefore, he gained 50%.

15. Since the jeweler lost 20%, or $\frac{1}{5}$ of the cost on one of the watches, he sold it for $\frac{4}{5}$ of the cost; that is, \$60 is $\frac{4}{5}$ of the cost; therefore, since \$60 is $\frac{4}{5}$ of \$75, one of the watches cost \$75.

Since he gained 20%, or $\frac{1}{5}$ of the cost on the other watch, he sold it for $\frac{6}{5}$ of the cost; that is, \$60 is $\frac{6}{5}$ of the cost; therefore, since \$60 is $\frac{6}{5}$ of \$50, the watch cost \$50.

Since one watch cost \$75 and the other \$50, both cost the sum of \$75 and \$50, or \$125; and since they were sold at \$60 each, both were sold for 2 times \$60, or \$120; therefore, the jeweler lost the difference between \$125 and \$120, or \$5.

16. Since the dealer sold the piano for 40%, or $\frac{2}{5}$ less than the catalogue price, he sold it for $\frac{3}{5}$ of the catalogue price, which is $\frac{3}{5}$ of \$500, or \$300.

Since he sold it for \$300 and made a profit of 25%, or $\frac{1}{4}$ of the cost, \$300 is $\frac{5}{4}$ of the cost; and since \$300 is $\frac{5}{4}$ of \$240, the piano cost \$240.

17. Since the drover gained 20%, or $\frac{1}{5}$ of the cost on one of the horses, he sold it for $\frac{6}{5}$ of the cost, that is, \$120 is $\frac{6}{5}$ of the cost; therefore, since \$120 is $\frac{6}{5}$ of \$100, the horse cost him \$100.

Since he lost 33 $\frac{1}{3}$ %, or $\frac{1}{3}$ of the cost on the other horse, he sold it for $\frac{2}{3}$ of the cost; that is, \$120 is $\frac{2}{3}$ of the cost; therefore, since \$120 is $\frac{2}{3}$ of \$180, the horse cost \$180.

Since one horse cost \$100 and the other \$180, they both cost the sum of \$100 and \$180, or \$280; and since they were sold at \$120 apiece, both were sold for 2 times \$120, or \$240; therefore, the drover lost the difference between \$280 and \$240, or \$40.

18. Since the furniture was bought for 16 $\frac{2}{3}$ % less than its value and sold for 16 $\frac{2}{3}$ % more than its value, there was a gain of 16 $\frac{2}{3}$ % + 16 $\frac{2}{3}$ %, or 33 $\frac{1}{3}$ %, or $\frac{1}{3}$ of its value; but the gain was \$60; therefore, \$60 is $\frac{1}{3}$ of the value of the furniture; hence, its value was 3 times \$60, or \$180.

19. \$7.50.

20. Since each had the same capital, the difference between 37% and 25% of it, or 12%, or $\frac{1}{5}$ of it is \$1080, the difference in their gains.

Since \$1080 is $\frac{1}{5}$ of the capital of each, and since \$1080 is $\frac{1}{5}$ of \$9000, the capital of each was \$9000.

Page 131.

2. \$400. 3. \$1000. 4. \$190. 5. \$45; \$5955. 6. \$6000.
7. \$25. 8. \$9. 9. \$60.

Page 132.

10. \$1500. 11. \$270. 13. \$2000. 14. \$100,000. 15. \$300.
16. \$8000.

Page 133.

17. Since the agent receives 8%, or $\frac{1}{12}$ of the sum expended for hogs; and since \$648 includes his commission and the sum to be expended for hogs, \$648 must be $\frac{13}{12}$ of the sum to be expended for hogs; therefore, since \$648 is $\frac{13}{12}$ of \$600, the sum to be expended for hogs is \$600.

Since the agent is to expend \$600 in hogs at \$6 each he can purchase as many hogs as \$6 is contained times in \$600, or 100 hogs.

18. Since the broker receives for his services $3\frac{1}{2}\%$, or $\frac{1}{8}$ of the sum invested in stock; and since \$6200 includes the commission and the sum invested, \$6200 must be $\frac{9}{8}$ of the sum invested in stock; therefore, since \$6200 is $\frac{9}{8}$ of \$6000, the broker invested \$6000 in stock; hence, his commission was \$6200 - \$6000, or \$200.

19. Since the agent receives for his services $1\frac{1}{2}\%$, or $\frac{1}{16}$ of the sum expended for wheat; and since \$8100 includes the commission and the sum expended for wheat, \$8100 is $\frac{17}{16}$ of the sum expended for wheat; therefore, since \$8100 is $\frac{17}{16}$ of \$8000, \$8000 was to be expended in wheat.

Since wheat was 80 cents, or $\frac{2}{3}$ per bushel, the agent could purchase as many bushels as $\frac{2}{3}$ is contained times in \$8000, or 10,000 bushels.

20. Since the broker receives for his services 4%, or $\frac{1}{25}$ of the value of the stock purchased; and since \$5200 includes the brokerage and the sum to be paid for stock, \$5200 must be $\frac{26}{25}$ of the sum to be paid for stock; therefore, since \$5200 is $\frac{26}{25}$ of \$5000, the sum to be paid for stock is \$5000.

Since \$5000 is to be paid for stock at \$25 per share, as many shares can be purchased as \$25 is contained times in \$5000, or 200 shares can be purchased.

2. \$1200. 3. \$70. 4. \$1400. 5. \$140. 6. \$63. 7. \$250.

Page 134.

8. Since a premium of 3% is paid, the premium is $\frac{3}{100}$ of the sum for which the ship is insured; and since it is insured for $\frac{2}{3}$ of its value, or $\frac{2}{3}$ of \$50,000, which is \$40,000, the premium is $\frac{3}{100}$ of \$40,000, or \$1200.

Since the owners will recover \$40,000 insurance, their loss will be \$50,000 - \$40,000, or \$10,000 and \$1200 premium; that is, they will lose \$10,000 + \$1200, or \$11,200, if the ship is wrecked.

9. \$9000.

10. Since the premium at $\frac{2}{3}$ of 1% for insuring some goods is \$20, \$20 is $\frac{2}{3}\%$, or $\frac{2}{100}$, or $\frac{2}{100}$ of the amount of the policy; and since \$20 is $\frac{2}{100}$ of \$2500, the amount of the policy is \$2500.

11. $1\frac{2}{3}\%$.

12. Since $\frac{2}{3}$ of A's share of the goods equals $\frac{1}{3}$ of B's share, $\frac{1}{3}$ of A's share equals $\frac{1}{2}$ of $\frac{1}{3}$ of B's share, or $\frac{1}{6}$ of B's share; therefore, $\frac{2}{3}$ of A's share, or all of his share, equals 3 times $\frac{1}{6}$ of B's share, or $\frac{1}{2}$ of B's share; consequently, A's share plus B's share equals $\frac{3}{2}$ of B's share plus $\frac{1}{2}$ of B's share, or $\frac{2}{1}$ of B's share; but the sum of their shares equals \$3400; therefore, $\frac{1}{1}$ of B's share is \$3400; and since \$3400 is $\frac{1}{2}$ of \$1600, B's share of the goods equals \$1600, and A's share equals \$3400 - \$1600, or \$1800.

Therefore, since a premium of 2% is paid, A should pay $\frac{2}{100}$, or $\frac{1}{50}$ of \$1800, which is \$36, and B should pay $\frac{1}{50}$ of \$1600, which is \$32.

13. 100.

2. \$16. 3. \$80. 4. \$48. 5. \$15. 6. \$35. 7. \$24. 8. \$11.
9. \$54.

Page 135.

10. \$6. 11. \$60. 12. \$88. 13. \$27. 14. \$56. 15. \$30.
16. \$60. 17. \$150. 18. \$43.75. 19. \$77. 21. $\frac{10}{100}$. 22. $\frac{10}{100}$.
23. $\frac{25}{100}$. 24. $\frac{15}{100}$. 25. $\frac{25}{100}$. 26. $\frac{125}{100}$. 27. $\frac{11}{100}$.

Page 136.

29. $\frac{15}{800}$. 30. $\frac{11}{400}$. 31. $\frac{71}{800}$. 32. $\frac{40}{300}$. 33. $\frac{112}{1000}$. 34. $\frac{111}{600}$.
 35. $\frac{121}{1700}$. 36. $\frac{12}{400}$. 38. \$87.50. 39. \$18. 40. \$25. 41. \$60.
 42. \$30. 43. \$20. 44. \$132. 45. \$14. 46. \$45. 47. \$12.25.
 48. \$.828.

Page 137.

2. Since the interest for 5 years at 5% is $\frac{1}{10}$, or $\frac{1}{4}$ of the principal, the amount for the same time and rate is $\frac{5}{4}$ of the principal; therefore, the amount of \$3600 for 5 yr. at 5% is $\frac{5}{4}$ of \$3600, or \$4500.

3. Since the interest for 6 yr. 3 mo. at 4% is $\frac{15}{100}$, or $\frac{1}{4}$ of the principal, the amount for the same time and rate is $\frac{5}{4}$ of the principal; therefore, the amount of \$120 for 6 yr. 3 mo. at 4% is $\frac{5}{4}$ of \$120, or \$150.

4. Since the interest for 5 yr. 6 mo. at 6% is $\frac{33}{100}$ of the principal, the amount for the same time and rate is $\frac{133}{100}$ of the principal; therefore, the amount of \$300 for 5 yr. 6 mo. at 6% is $\frac{133}{100}$ of \$300, or \$399.

5. Since the interest for 3 yr. 3 mo. at 8% is $\frac{27}{100}$ of the principal, the amount for the same time and rate is $\frac{127}{100}$ of the principal; therefore, the amount of \$4000 for 3 yr. 3 mo. at 8% is $\frac{127}{100}$ of \$4000, or \$5040.

6. Since the interest for 2 yr. 6 mo. at 5% is $\frac{12\frac{1}{2}}{100}$, or $\frac{1}{8}$ of the principal, the amount for the same time and rate is $\frac{8}{7}$ of the principal; therefore, the amount of \$640 for 2 yr. 6 mo. at 5% is $\frac{8}{7}$ of \$640, or \$720.

7. Since the interest for 1 yr. 5 mo. at 12% is $\frac{17}{100}$ of the principal, the amount for the same time and rate is $\frac{117}{100}$ of the principal; therefore, the amount of \$800 for 1 yr. 5 mo. at 12% is $\frac{117}{100}$ of \$800, or \$936.

8. Since the interest for 3 yr. 8 mo. at 3% is $\frac{11}{100}$ of the principal, the amount for the same time and rate is $\frac{111}{100}$ of the principal; therefore, the amount of \$1000 for 3 yr. 8 mo. at 3% is $\frac{111}{100}$ of \$1000, or \$1110.

9. Since the interest for 3 yr. 3 mo. 15 da. at 8% is $\frac{72}{100}$ of the principal, the amount for the same time and rate is $\frac{172}{100}$ of the principal; therefore, the amount of \$6000 for 3 yr. 3 mo. 15 da. at 8% is $\frac{172}{100}$ of \$6000, or \$7580.

10. Since the interest for 1 yr. 1 mo. 24 da. at 5% is $\frac{1}{20}$ of the principal, the amount for the same time and rate is $\frac{21}{20}$ of the principal; therefore, the amount of \$400 for 1 yr. 1 mo. 24 da. at 5% is $\frac{21}{20}$ of \$400, or \$423.

11. Since the interest for 60 da. at 6% is $\frac{1}{10}$ of the principal, the amount for the same time and rate is $\frac{11}{10}$ of the principal; therefore, the amount of \$240 for 60 da. at 6% is $\frac{11}{10}$ of \$240, or \$264.

12. Since the interest for 90 da. at 8% is $\frac{3}{25}$ of the principal, the amount for the same time and rate is $\frac{28}{25}$ of the principal; therefore, the amount of \$900 for 90 da. at 8% is $\frac{28}{25}$ of \$900, or \$1008.

13. Since the interest for 30 da. at 4% is $\frac{1}{25}$ of the principal, the amount for the same time and rate is $\frac{26}{25}$ of the principal; therefore, the amount of \$6000 for 30 da. at 4% is $\frac{26}{25}$ of \$6000, or \$6240.

14. Since the interest for 45 da. at 4% is $\frac{3}{80}$ of the principal, the amount for the same time and rate is $\frac{83}{80}$ of the principal; therefore, the amount of \$4800 for 45 da. at 4% is $\frac{83}{80}$ of \$4800, or \$4980.

15. Since the interest for 75 da. at 5% is $\frac{1}{8}$ of the principal, the amount for the same time and rate is $\frac{9}{8}$ of the principal; therefore, the amount of \$9600 for 75 da. at 5% is $\frac{9}{8}$ of \$9600, or \$10800.

16. Since the interest for 5 yr. 4 mo. 18 da. at 4% is $\frac{1}{25}$ of the principal, the amount for the same time and rate is $\frac{26}{25}$ of the principal; therefore, the amount of \$3000 for 5 yr. 4 mo. 18 da. at 4% is $\frac{26}{25}$ of \$3000, or \$3120.

17. Since the interest for 3 yr. 3 mo. 10 da. at 6% is $\frac{1}{5}$ of the principal, the amount for the same time and rate is $\frac{6}{5}$ of the principal; therefore, the amount of \$1200 for 3 yr. 3 mo. 10 da. at 6% is $\frac{6}{5}$ of \$1200, or \$1440.

18. Since the interest for 2 yr. 6 mo. 20 da. at 3% is $\frac{1}{10}$ of the principal, the amount for the same time and rate is $\frac{11}{10}$ of the principal; therefore, the amount of \$1500 for 2 yr. 6 mo. 20 da. at 3% is $\frac{11}{10}$ of \$1500, or \$1650.

19. Since the interest for 3 yr. at 5% is $\frac{3}{20}$ of the principal, the amount for the same time and rate is $\frac{17}{20}$ of the principal; therefore, the amount of \$1000 for 3 yr. at 5% is $\frac{17}{20}$ of \$1000, or \$1700.

Since A's share of the amount is to be $\frac{2}{3}$ of B's, for every dollar of B's share there is $\frac{2}{3}$ of A's share and $\frac{5}{3}$ of the sum of their shares;

therefore, B's share is as many dollars as $\$1\frac{1}{2}$ is contained times in $\$1150$, or $\$690$, and A's share is $\frac{2}{3}$ of $\$690$, or $\$460$.

20. Since the interest for 4 yr. at 5% is $\frac{2}{10}$, or $\frac{1}{5}$ of the principal, the amount for the same time and rate is $\frac{6}{5}$ of the principal; therefore, the amount of $\$5000$ for 4 yr. at 5% is $\frac{6}{5}$ of $\$5000$, or $\$6000$.

Since A is to have twice as much as B, for every dollar of B's share, there is 2 dollars of A's share and 3 dollars of the sum of their shares; therefore, B's share of the amount is as many dollars as $\$3$ is contained times in $\$6000$, or $\$2000$, and A's share is 2 times $\$2000$, or $\$4000$.

Page 138.

21. Since the amount of my money for 2 yr. 6 mo. at 6% is $\frac{3}{5}$ of the principal and for 4 yr. at 5% is $\frac{2}{3}$ of the principal, and since the amount for 2 yr. 6 mo. at 6% is $\$250$ less than the amount for 4 yr. at 5%, $\$250$ is $\frac{3}{5} - \frac{2}{3}$, or $\frac{1}{15}$ of the principal; therefore, I have 20 times $\$250$, or $\$5000$.

22. Since the interest for 4 yr. 6 mo. at 4% is $\frac{1}{5}$ of the principal, the interest of $\$3000$ for 4 yr. 6 mo. at 4% is $\frac{1}{5}$ of $\$3000$, or $\$600$.

Since I received $\$1$ of the interest for every $\$2$ my brother received and every $\$3$ we both received, my share was as many dollars as $\$3$ is contained times in $\$600$, or $\$180$, and my brother's share was 2 times $\$180$, or $\$360$.

23. Since the interest for 3 yr. 6 mo. at $4\frac{1}{2}\%$ is $\frac{3}{8}$ of the principal, the amount for the same time and rate is $\frac{11}{8}$ of the principal; therefore, the amount due on a note for $\$8000$ at the end of 3 yr. 6 mo. at $4\frac{1}{2}\%$ is $\frac{11}{8}$ of $\$8000$, or $\$9260$.

2. $\$1000$. 3. $\$16,000$. 4. $\$4575$. 5. $\$13,000$. 6. $\$15,000$. 7. $\$120$.

Page 139.

8. $\$600$.

9. Since the interest of any sum for 3 yr. 5 mo. at 6% is $\frac{11}{20}$ of the principal, A's interest is $\frac{11}{20}$ of his principal, and since the interest of any sum for 4 yr. 3 mo. at 8% is $\frac{34}{100}$, or $\frac{17}{50}$ of the principal, B's interest is $\frac{17}{50}$ of his principal.

Since A's money yields $\$81$ less than B's, and since they have equal sums on interest, $\$81$ is $\frac{17}{50} - \frac{11}{20}$, or $\frac{7}{100}$ of the sum each has on interest; $\frac{7}{100}$ of this sum is $\frac{1}{14}$ of $\$81$, or $\$3$, and the sum each has on interest is 20 times $\$3$, or $\$600$.

10. Since the interest of any sum for 6 years at 5% is $\frac{30}{100}$ of the sum and the interest of the same sum for 3 years at 6% is $\frac{18}{100}$ of the sum, and since the interest of a sum for 6 years at 5% is \$600 more than the interest of the same sum for 3 years at 6%, \$600 is $\frac{30}{100} - \frac{18}{100}$, or $\frac{12}{100}$ of the sum; $\frac{1}{10}$ of the sum is $\frac{1}{12}$ of \$600, or \$50, and the sum is 100 times \$50, or \$5000.

11. Since the interest of any sum for 2 yr. 8 mo. at 6% is $\frac{16}{100}$ of that sum, if each had put all his money at interest at the given rate, the interest of each would have been $\frac{16}{100}$ of the sum inherited; but since one invested only $\frac{2}{3}$ of his money, his interest was only $\frac{2}{3}$ of $\frac{16}{100}$, or $\frac{16}{150}$ of his inheritance, and since the second invested only $\frac{1}{3}$ of his inheritance, his interest was only $\frac{1}{3}$ of $\frac{16}{100}$, or $\frac{16}{300}$ of his inheritance.

Since they inherited equal sums, their combined interest was $\frac{16}{150} + \frac{16}{300}$, or $\frac{32}{300}$ of the inheritance of either; but their combined interest was \$2720; therefore, $\frac{32}{300}$ of the inheritance of each was \$2720; $\frac{1}{300}$ of the inheritance of each was $\frac{1}{32}$ of \$2720, or \$85, and each inherited 300 times \$85, or \$25,500.

12. Since the interest of any sum for 1 yr. 8 mo. at 6% is $\frac{16}{100}$, or $\frac{1}{10}$ of the principal, \$32 is $\frac{1}{10}$ of the money paid for the horse and wagon; therefore, 10 times \$32, or \$320, was paid for the horse and wagon.

Since $\frac{2}{3}$ of the cost of the wagon was $\frac{2}{3}$ of the cost of the horse, $\frac{1}{3}$ of the cost of the wagon was $\frac{1}{3}$ of the cost of the horse, and $\frac{2}{3}$, or the whole cost of the wagon, was $\frac{2}{3}$ of the cost of the horse; therefore, the cost of the wagon plus the cost of the horse was $\frac{2}{3}$ of the cost of the horse plus $\frac{2}{3}$ of the cost of the horse, or $\frac{4}{3}$ of the cost of the horse; but the cost of the wagon plus the cost of the horse was \$320; therefore, \$320 was $\frac{4}{3}$ of the cost of the horse, and since \$320 is $\frac{4}{3}$ of \$240, the horse cost \$240; consequently, the wagon cost \$320 - \$240, or \$80.

13. Since a merchant's income was reduced from 12% annually on his investment to 7% annually, it was reduced 5% annually, or $\frac{5}{100}$ of his investment annually, and since 2 yr. 3 mo. 6 da. = $\frac{27}{12}$ yr., in 2 yr. 3 mo. 6 da. his income was reduced $\frac{27}{12}$ of $\frac{5}{100}$, or $\frac{27}{240}$ of his investment; and since it was reduced \$6800, $\frac{27}{240}$ of his investment was \$6800; $\frac{1}{240}$ of his investment was $\frac{1}{27}$ of \$6800, or \$252, and his investment was 240 times \$252, or \$60,480.

14. Since the time from April 15, 1897, to June 30, 1897, is 2 mo. 15 da., the note was on interest for 2 mo. 15 da.

Since the interest of any sum for 2 mo. 15 da. at 6% is $\frac{1}{10}$ of the

principal, and since the interest on the note was \$25, \$25 was $\frac{1}{8}$ of the face of the note, and the face of the note was 80 times \$25, or \$2000; therefore, the sheep cost \$2000.

Since 400 sheep cost \$2000, 1 sheep cost $\frac{1}{400}$ of \$2000, or \$5; that is, the sheep cost \$5 per head.

Page 140.

2. \$300. 3. \$8800. 4. \$2000. 5. \$3000. 6. \$3600.

7. Since the interest of any sum for 3 yr. 5 mo. 10 da. at 6% is $\frac{1}{10}$ of the principal and the amount for that time is $\frac{11}{10}$ of the principal, \$3620 is $\frac{11}{10}$ of the money A and B have; $\frac{1}{10}$ of their money is $\frac{1}{11}$ of \$3620, which is \$330; and they have 300 times \$330, or \$99,000.

Since A's money is twice B's, for every dollar B has A has \$2 and they together have \$3; therefore, since they together have \$99,000, B has as many dollars as \$3 is contained times in \$99,000, or \$33,000, and A has 2 times \$33,000, or \$66,000.

8. Since the interest of any sum for 1 yr. 8 mo. at 6% is $\frac{1}{10}$ of the principal, and the amount for the same time is $\frac{11}{10}$ of the principal, \$18,700 is $\frac{11}{10}$ of the money M and N have; $\frac{1}{10}$ of their money is $\frac{1}{11}$ of \$18,700, which is \$1700; and they have 10 times \$1700, or \$17,000.

Since $\frac{2}{3}$ of M's money is equal to $\frac{1}{3}$ of N's, $\frac{1}{3}$ of M's is equal to $\frac{1}{6}$ of N's, or $\frac{1}{3}$ of N's, and $\frac{1}{3}$, or all of M's is equal to 3 times $\frac{1}{3}$, or $\frac{1}{3}$ of N's; therefore, M's money plus N's money equals $\frac{4}{3}$ of N's plus $\frac{1}{3}$ of N's, or $\frac{5}{3}$ of N's; but M's money plus N's money equals \$17,000; therefore, $\frac{5}{3}$ of N's money equals \$17,000; $\frac{1}{3}$ of his money equals $\frac{1}{5}$ of \$17,000, or \$3400; and N's money equals 8 times \$3400, or \$27,200; consequently, M has \$17,000 - \$27,200, or \$10,200.

9. Since the interest of any sum for 2 yr. 3 mo. at 4% is $\frac{1}{10}$ of the principal, and the amount for the same time is $\frac{11}{10}$ of the principal, \$1199 is $\frac{11}{10}$ of the money A and B had at interest; $\frac{1}{10}$ of what they had at interest is $\frac{1}{11}$ of \$1199, which is \$11; and they had at interest 100 times \$11, or \$1100; and since they had $\frac{1}{2}$ of their money at interest A and B have 2 times \$1100, or \$2200.

Since A's money is $\frac{1}{2}$ of B's, for every dollar B has A has \$2 and they together have \$3, and since they have in all \$2200, B has as many dollars as \$3 is contained times in \$2200, or \$733.33; consequently, A has \$2200 - \$733.33, or \$1466.67.

10. Since the interest of any sum for 3 yr. 9 mo. at 8% is $\frac{1}{10}$ of the principal, the amount for the same time is $\frac{11}{10}$ of the principal; therefore, the amount of \$10,000 for 3 yr. 9 mo. at 8% is $\frac{11}{10}$ of \$10,000, or \$13,000.

Since \$13,000 is to be divided into two parts that are to each other as 8 to 5, the first part will be $\frac{8}{13}$ of \$13,000, or \$8000, and the second will be $\frac{5}{13}$ of \$13,000, or \$5000; since these parts are respectively $\frac{1}{2}$ of A's money and $\frac{2}{3}$ of B's money $\frac{1}{2}$ of A's money is \$8000; therefore, A has 2 times \$8000, or \$16,000; $\frac{2}{3}$ of B's money is \$5000; $\frac{1}{3}$ of it is $\frac{1}{2}$ of \$5000, or \$2500; and B has 3 times \$2500, or \$7500.

Page 141.

2. 4 yr. 3. 2 mo. 4. 3 mo. 5. 2 yr. 8 mo. 6. 1 yr. 10 mo.
7. 5 yr. 8. 3 yr. 4 mo. 9. 5 yr. 10. $16\frac{2}{3}$ yr. 11. 20 yr.; $12\frac{1}{2}$ yr.;
25 yr.; 5 yr.; 4 yr.

12. Since the interest for one year at 10% is $\frac{1}{10}$ of the principal, and the entire interest is $\frac{2}{10}$ of the principal, it will require as many years for a principal to treble itself at 10% as $\frac{1}{10}$ is contained times in $\frac{2}{10}$, or 20 years.

Reasoning similarly, it is found that a principal will treble itself at 12% in $16\frac{2}{3}$ years, at 5% in 40 years, at 40% in 5 years, and at 50% in 4 years.

13. Since the debt with interest at 5% will amount to \$750, and with interest at 8% to \$840, the interest of the debt for the whole time at 8% - 5%, or 3%, will be \$840 - \$750, or \$90; therefore, at 1% the interest of the debt for the whole time will be $\frac{1}{3}$ of \$90, or \$30, and at 5% it will be 5 times \$30, or \$150.

Since the debt at 5% interest will amount to \$750, and since at that rate the interest will be \$150, the debt is \$750 - \$150, or \$600.

Since in one year at 5% the interest on \$600 is \$30, to yield \$150 interest would require as many years as \$30 is contained times in \$150, or 5 years.

Hence, the debt is \$600, and the time is 5 years.

Page 142.

2. 4%. 3. $7\frac{1}{2}$ %. 4. 9%. 5. 4%. 6. 6%. 7. $4\frac{1}{2}$ %. 8. 10%
9. 12%. 10. 4%. 11. 6%.

12. Since the amount of a certain principal for 5 years at a certain rate is \$665, and for 8 years at the same rate \$779, the interest of that principal at the same rate for 8 - 5, or 3 years is \$779 - \$665, or \$114; therefore, the interest for 1 year is $\frac{1}{3}$ of \$114, or \$38, and the interest for 5 years is 5 times \$38, or \$190; hence, the principal is \$665 - \$190, or \$475.

Since at 1% the interest of \$475 for 5 years is \$23 $\frac{1}{4}$, to yield \$190 interest the rate must be as many times 1% as \$23 $\frac{1}{4}$ is contained times in \$190, or 8 times 1%, or 8%. Hence, the rate is 8%, and the principal is \$475.

Page 143.

1. Since a man gets \$75 per month and saves 20%, or $\frac{1}{5}$ of it, he saves $\frac{1}{5}$ of \$75, or \$15 per month; therefore, in a year he saves 12 times \$15, or \$180.

2. Since I bought 80 bushels of potatoes at 50 cents, or \$ $\frac{1}{2}$ a bushel, I paid 80 times \$ $\frac{1}{2}$, or \$40 for them; and since those which were salable were sold so that 12 $\frac{1}{2}$ %, or $\frac{1}{8}$ was gained by the transaction, they were sold for $\frac{8}{9}$ of \$40, or \$45.

Since 25%, or $\frac{1}{4}$ of the potatoes were unsalable, $\frac{3}{4}$ of 80 bushels, or 60 bushels were sold for \$45; therefore, they were sold for $\frac{3}{4}$ of \$45, or \$ $\frac{3}{4}$, or 75 cents per bushel.

3. Since on one of the coats there was a gain of 20%, or $\frac{1}{5}$ of the cost, it was sold for $\frac{6}{5}$ of the cost; that is, \$30 is $\frac{6}{5}$ of the cost; therefore, since \$30 is $\frac{6}{5}$ of \$25, one of the coats cost \$25.

Since on the other coat there was a loss of 20%, or $\frac{1}{5}$ of the cost, it was sold for $\frac{4}{5}$ of the cost; that is, \$30 is $\frac{4}{5}$ of the cost; therefore, since \$30 is $\frac{4}{5}$ of \$37 $\frac{1}{2}$, the other coat cost \$37 $\frac{1}{2}$.

Since one coat cost \$25 and the other \$37 $\frac{1}{2}$, both cost the sum of \$25 and \$37 $\frac{1}{2}$, or \$62 $\frac{1}{2}$; and since they were sold at \$30 apiece, both were sold for 2 times \$30, or \$60; therefore, the loss was the difference between \$62 $\frac{1}{2}$ and \$60, or \$2 $\frac{1}{2}$.

4. Since by selling the horse for \$180, I gain 20%, or $\frac{1}{5}$ of the cost, \$180 is $\frac{6}{5}$ of the cost; and since \$180 is $\frac{6}{5}$ of \$150, the horse cost \$150.

Since the horse cost \$150, in order to gain 33 $\frac{1}{3}$ %, or $\frac{1}{3}$ of the cost, it should be sold for $\frac{4}{3}$ of \$150, or \$200.

5. Since, if the piano dealer gives a discount of 25%, or $\frac{1}{4}$ of his price, he sells for $\frac{3}{4}$ of his price, if he gives a further discount of 20%, or $\frac{1}{5}$ from the remainder, he sells for $\frac{3}{5}$ of $\frac{3}{4}$, or $\frac{9}{20}$ of his price.

Since he sells for $\frac{2}{3}$ of his price, he allows a discount of $\frac{1}{3}$, or 40% of his price.

6. Since a discount of 30%, or $\frac{3}{10}$ of the catalogue price was made, the remainder was $\frac{7}{10}$ of that price, or $\frac{7}{10}$ of \$600, which is \$420; and since a further discount of 20%, or $\frac{1}{5}$ was made from the remainder, $\frac{4}{5}$ of \$420, or \$336, was paid for the piano.

7. Since the merchant sold cloth at \$2.40 per yard and gained 20%, or $\frac{1}{5}$ of the cost, \$2.40 is $\frac{6}{5}$ of the cost per yard; and since \$2.40 is $\frac{6}{5}$ of \$2, the cloth cost \$2 per yard.

Since he marked it to sell at a loss of 25%, or $\frac{1}{4}$ of the cost, the second selling price was $\frac{3}{4}$ of the cost, or $\frac{3}{4}$ of \$2, which is \$1 $\frac{1}{2}$, or \$1.50.

8. Since the man paid 20%, or $\frac{1}{5}$ of his money for a house, he had left $\frac{4}{5}$ of his money; and since he paid 30%, or $\frac{3}{10}$ of the remainder for a store, he paid $\frac{9}{50}$ of $\frac{4}{5}$, or $\frac{12}{62.5}$ of his money for the store; therefore, he paid $\frac{9}{50} - \frac{1}{5}$, or $\frac{1}{25}$ of his money more for the store than for the house; but he paid \$200 more for the store than for the house; therefore, \$200 is $\frac{1}{25}$ of his money; consequently, he had 25 times \$200, or \$5000.

Since he paid $\frac{1}{5}$ of his money for a house, the house cost him $\frac{1}{5}$ of \$5000, or \$1000, and since he paid $\frac{1}{5}$ of his money for a store, the store cost him $\frac{1}{5}$ of \$5000, or \$1200.

9. Since at 1% the interest for 16 yr. 8 mo., or 16 $\frac{2}{3}$ yr. is 16 $\frac{2}{3}$ times $\frac{1}{100}$, or $\frac{16\frac{2}{3}}{100}$ of the principal, and at the required rate the interest is $\frac{1}{33\frac{1}{3}}$ of the principal, in order that a principal may double itself in 16 yr. 8 mo., the rate must be as many times 1% as $\frac{16\frac{2}{3}}{100}$ is contained times in $\frac{1}{33\frac{1}{3}}$, or 6 times 1%, or 6%.

10. Since the amount of a certain principal at a certain rate for 3 years is \$552, and for 7 years is \$648, the interest on that principal at the same rate for 7 - 3, or 4 years is \$648 - \$552, or \$96, and the interest for 1 year is $\frac{1}{4}$ of \$96, or \$24; therefore, the interest for 3 years is 3 times \$24, or \$72; since the interest on a certain principal for 3 years is \$72, and the amount for the same time is \$552, the principal is \$552 - \$72, or \$480.

Since at 1% the interest of \$480 for 3 years is \$14.40, to yield \$72 interest the rate must be as many times 1% as \$14.40 is contained times in \$72, or 5 times 1%, or 5%.

Hence, the principal is \$480, and the rate is 5%.

Page 144.

11. Since my grocer gets 20%, or $\frac{1}{5}$ of my salary, there is left $\frac{4}{5}$ of it; and since my butcher gets 10%, or $\frac{1}{10}$ of the remainder, he gets $\frac{1}{10}$ of $\frac{4}{5}$, or $\frac{2}{25}$ of my salary; therefore, my grocer gets $\frac{1}{5} - \frac{2}{25}$, or $\frac{3}{25}$ of my salary more than my butcher; but my grocer gets \$600 more than my butcher; therefore, \$600 is $\frac{3}{25}$ of my salary; and since \$600 is $\frac{3}{25}$ of \$5000, my salary is \$5000.

12. Since 40% of the farmer's wheat is $\frac{2}{5}$ of it, and 75% of his rye is $\frac{3}{4}$ of it, $\frac{2}{5}$ of the farmer's wheat was equal to $\frac{3}{4}$ of his rye; therefore $\frac{1}{5}$ of his wheat was $\frac{1}{4}$ of $\frac{3}{4}$, or $\frac{1}{3}$ of his rye, and $\frac{2}{3}$, or all of his wheat, was 5 times $\frac{1}{3}$, or $\frac{1}{3}$ of his rye; hence, the whole number of bushels of both that he raised equals $\frac{1}{3}$ of the number of bushels of rye plus $\frac{2}{3}$ of the number of bushels of rye, or $\frac{1}{3}$ of the number of bushels of rye; but he raised 4600 bushels of both; therefore, 4600 bushels is $\frac{1}{3}$ of the number of bushels of rye; and since 4600 is $\frac{1}{3}$ of 13800, he raised 13800 bushels of rye; consequently, he raised 4600 - 13800, or 3000 bushels of wheat.

13. Since 40%, or $\frac{2}{5}$ of A's money is in coin, and 30%, or $\frac{3}{10}$ of it is in bills, $\frac{2}{5} + \frac{3}{10}$, or $\frac{7}{10}$ of it is in coin and bills, and the remaining $\frac{3}{10}$ of it is loaned; but \$900 is loaned; therefore, \$900 is $\frac{3}{10}$ of A's money; and since \$900 is $\frac{3}{10}$ of \$3000, A has \$3000.

14. Since B sold a horse to C for \$150, and thereby lost 25%, or $\frac{1}{4}$ of the cost, \$150 is $\frac{3}{4}$ of what the horse cost B; and since \$150 is $\frac{3}{4}$ of \$200, the horse cost B \$200.

Since A sold the horse to B for \$200, at a loss of 20%, or $\frac{1}{5}$ of the cost, \$200 is $\frac{4}{5}$ of what A paid for the horse; and since \$200 is $\frac{4}{5}$ of \$250, A paid \$250 for the horse.

15. Since Mr. Brown sold his horse so that 75%, or $\frac{3}{4}$ of what he paid for it was equal to 60%, or $\frac{3}{5}$ of the selling price, $\frac{1}{4}$ of what he paid for it was equal to $\frac{1}{5}$ of $\frac{3}{5}$, or $\frac{1}{5}$ of the selling price; therefore, $\frac{3}{5}$ of the selling price, or the whole selling price, was 5 times $\frac{1}{5}$, or $\frac{1}{5}$ of what he paid for it.

Since the selling price was $\frac{1}{5}$ of the cost, Mr. Brown gained $\frac{1}{5}$ of the cost, or 25%.

16. Since, if the piano dealer gives a discount of 20%, or $\frac{1}{5}$ of the marked price of a piano, he sells it for $\frac{4}{5}$ of the marked price; if he gives a further discount of 20%, or $\frac{1}{5}$ of the remainder, he sells it for

$\frac{2}{3}$ of $\frac{3}{4}$, or $\frac{1}{2}$ of the marked price; but he is to get \$320 for it; therefore, \$320 is $\frac{1}{2}$ of the marked price; and since \$320 is $\frac{1}{2}$ of \$500, the marked price is \$500.

17. Since the coat cost \$30, and there is to be a profit of 20%, or $\frac{1}{5}$ of the cost, the selling price will be $\frac{6}{5}$ of \$30, or \$36.

Since the selling price is \$36, and there is to be a discount of 10%, or $\frac{1}{10}$ from the marked price, \$36 is $\frac{9}{10}$ of the marked price; and since \$36 is $\frac{9}{10}$ of \$40, the coat must be marked at \$40.

18. Since the dealer gets as much for 3 pounds of tea as 4 pounds cost him, he gains the cost of 1 pound on the cost of 3 pounds; therefore, he gains $\frac{1}{4}$ of the cost, or 33 $\frac{1}{3}$ %.

19. Since I am to sell the sheep at a gain of 20%, or $\frac{1}{5}$ of the cost, and make a profit of \$25, \$25 is $\frac{1}{5}$ of the cost of the sheep, and their cost is 5 times \$25, or \$125.

Since the sheep cost \$5 each, and they all cost \$125, there must be as many sheep as \$5 is contained times in \$125, or 25 sheep.

Page 145.

20. Since by selling a bale of goods for \$80 less than cost there was a loss of 10%, or $\frac{1}{10}$ of the cost, \$80 is $\frac{9}{10}$ of the cost; therefore, the goods cost 10 times \$80, or \$800.

Since the bale of goods cost \$800, to gain 25%, or $\frac{1}{4}$ of the cost, it should have been sold for $\frac{5}{4}$ of \$800, or \$1000.

21. Since a pound of one kind of coffee cost 18 cents and of the other 22 cents, a pound of a mixture containing equal parts of the two kinds will cost $\frac{1}{2}$ of (18 + 22), or 20 cents.

Since the mixture was sold so as to gain 25%, or $\frac{1}{4}$ of the cost, the selling price was $\frac{5}{4}$ of 20 cents, or 25 cents per pound.

22. Since the number of oxen is 60% of the number of sheep, the number of oxen is $\frac{3}{5}$ of the number of sheep; and since the number of horses is 40%, or $\frac{2}{5}$ of the number of oxen, the number of horses is $\frac{2}{5}$ of $\frac{3}{5}$, or $\frac{6}{25}$ of the number of sheep; therefore, the whole number of animals is the number of sheep plus $\frac{3}{5}$ of the number of sheep plus $\frac{6}{25}$ of the number of sheep, or $\frac{5}{5} + \frac{3}{5} + \frac{6}{25}$, or $\frac{18}{5}$ of the number of sheep; but the whole number of animals is 1840; therefore, 1840 is $\frac{18}{5}$ of the number of sheep; and since 1840 is $\frac{18}{5}$ of 1000, the drover has 1000 sheep; therefore, he has $\frac{3}{5}$ of 1000, or 600 oxen, and $\frac{2}{5}$ of 1000, or 240 horses.

23. Since 30% of a number is $\frac{1}{10}$ of it, 30% of $\frac{1}{2}$ of the required number is $\frac{1}{10}$ of $\frac{1}{2}$, or $\frac{1}{20}$ of it; and since 40% of a number is $\frac{2}{5}$ of it, 40% of $\frac{1}{2}$ of the required number is $\frac{2}{5}$ of $\frac{1}{2}$, or $\frac{1}{5}$ of it; therefore, since 30% of $\frac{1}{2}$ of the number is 27 less than 40% of $\frac{1}{2}$ of it, $\frac{1}{20}$ of the number is 27 less than $\frac{1}{5}$ of it; hence, $\frac{1}{5} - \frac{1}{20}$, or $\frac{1}{20}$ of the number is 27; $\frac{1}{20}$ of the number is $\frac{1}{2}$ of 27, or 3; and the number is 100 times 3, or 300.

24. Since in a mixture of two kinds of tea 60% of it was one kind, 40% of it was the other kind; therefore, in 100 pounds of the mixture there would be 60%, or $\frac{3}{5}$ of 100 pounds, or 60 pounds, of the 40 cent tea, and 40%, or $\frac{2}{5}$ of 100 pounds, or 40 pounds of the 50 cent tea; hence, the cost of 100 pounds of the mixture is the sum of 60 times 40 cents, or \$24, and 40 times 50 cents, or \$20, which is \$44; therefore, the mixture cost 44 cents per pound.

Since the mixture cost 44 cents per pound, in order to gain 25%, or $\frac{1}{4}$ of the cost, it should be sold for $\frac{5}{4}$ of 44 cents, or 55 cents per pound.

25. Since the boy lost 20% of his marbles he lost $\frac{1}{5}$ of them and then had left $\frac{4}{5}$ of what he had at first; and when he had purchased a number equal to 50%, or $\frac{1}{2}$ of this remainder, he purchased $\frac{1}{2}$ of $\frac{4}{5}$, or $\frac{2}{5}$ as many as he had at first, and then had $\frac{1}{5} + \frac{2}{5}$, or $\frac{3}{5}$ as many as he had at first; but he then had 72 marbles; therefore, 72 marbles is $\frac{3}{5}$ of the number he had at first; and since 72 is $\frac{3}{5}$ of 60, he had 60 marbles at first.

26. Since a ton of hay is bought for 80%, or $\frac{4}{5}$ of the market price and sold at a gain of $37\frac{1}{2}\%$, or $\frac{3}{8}$ of the cost, it is sold for $\frac{11}{8}$ of the cost, or $\frac{11}{8}$ of $\frac{4}{5}$, or $\frac{11}{10}$ of the market price; therefore, it is sold at $\frac{11}{10}$ above the market price, or 10% above the market price.

27. Since there was a gain of 25%, or $\frac{1}{4}$ of the capital, the amount of the capital and gain is $\frac{5}{4}$ of the capital; but the amount of the capital and gain is \$2000; therefore, \$2000 is $\frac{5}{4}$ of the capital; hence, $\frac{1}{4}$ of the capital, which is the gain, is $\frac{1}{5}$ of \$2000, or \$400.

Since A furnished 60%, or $\frac{3}{5}$ of the capital, and B the rest, B furnished $\frac{2}{5}$ of the capital; therefore, A should receive $\frac{3}{5}$ of the gain and B $\frac{2}{5}$ of the gain; hence, A's share is $\frac{3}{5}$ of \$400, or \$240, and B's share is $\frac{2}{5}$ of \$400, or \$160.

28. Since, after expending \$40 more than 40%, or $\frac{2}{5}$ of his money, a clerk has \$140 left, if he had spent only $\frac{2}{5}$ of his money, he would have had \$140 + \$40, or \$180 left; therefore, \$180 is $\frac{2}{5} - \frac{2}{5}$, or $\frac{3}{5}$ of his money; and since \$180 is $\frac{3}{5}$ of \$300, he had \$300 at first.

Page 146.

29. Since I marked cloth to sell at a gain of 40%, the marked price was 140% of the cost; and since I gained only 30%, the actual price received was 130% of the cost; therefore, the actual price was $\frac{13}{14}$ of the marked price on account of using an incorrect measure; that is, any number of yards sold contained the measuring stick only $\frac{13}{14}$ as many times as it should have contained it; hence, 1 yard of cloth was sold for $\frac{13}{14}$ of a yard; consequently, the measuring stick was $1 \div \frac{13}{14}$, or $\frac{14}{13}$ of a yard long; that is, it was $\frac{14}{13}$ of 36 inches, or $38\frac{2}{13}$ inches long.

30. Since I pay \$48 for insuring my house for part of its value at $\frac{4}{5}\%$, \$48 is $\frac{4}{5}\%$, or $\frac{4}{500}$, or $\frac{1}{125}$ of the sum for which my house is insured; therefore, it is insured for 125 times \$48, or \$6000.

Since my house worth \$8000 is insured for \$6000, it is insured for $\frac{8000}{6000}$, or $\frac{4}{3}$ of its value.

31. At 35 cents, or $\frac{7}{20}$ a pound, 2000 pounds of tea will cost 2000 times $\frac{7}{20}$, or \$700; and since the commission is 4% of the sum invested, it is 4%, or $\frac{4}{100}$ of \$700, or \$28.

Hence, to pay for 2000 pounds of tea at 35 cents a pound and a commission of 4%, I should send my agent the sum of \$700 and \$28, or \$728.

32. Since a dealer asked for a reaper 30%, or $\frac{3}{10}$ more than it cost, he asked for it $\frac{13}{10}$ of the cost; and since he took 10%, or $\frac{1}{10}$ less than his asking price he took $\frac{9}{10}$ of his asking price, or $\frac{9}{10}$ of $\frac{13}{10}$, or $\frac{117}{100}$ of the cost.

Since he received $\frac{117}{100}$ of the cost, he gained $\frac{17}{100}$ of the cost; but he gained \$34; therefore, \$34 is $\frac{17}{100}$ of the cost of the reaper; and since \$34 is $\frac{17}{100}$ of \$200, the reaper cost \$200.

Since the reaper cost \$200 and he asked for it $\frac{13}{10}$ of the cost, he asked $\frac{13}{10}$ of \$200, or \$260.

33. Since the article absorbed 6 ounces of water and then weighed 5 pounds, or 80 ounces, the weight of the water absorbed was $\frac{6}{80}$, or $\frac{3}{40}$ of the weight of the article when damp; therefore, since $\frac{3}{40} = \frac{7\frac{1}{2}}{100}$, the water absorbed was $7\frac{1}{2}\%$ of the weight of the article when damp.

34. Since the man is to make 20%, or $\frac{1}{5}$ on the cost, the selling price is $\frac{6}{5}$ of the cost; and since he is to take off 10%, or $\frac{1}{10}$ from the marked price, the selling price is $\frac{9}{10}$ of the marked price; therefore, $\frac{9}{10}$ of the

marked price is $\frac{2}{3}$ of the cost; $\frac{1}{10}$ of the marked price is $\frac{1}{3}$ of $\frac{2}{3}$, or $\frac{2}{15}$ of the cost; and the marked price is 10 times $\frac{1}{15}$, or $\frac{2}{3}$ of the cost, or $\frac{133\frac{1}{3}}{100}$ of the cost; therefore, he must mark his goods $33\frac{1}{3}\%$ above cost.

35. Since the agent was to deduct \$14 for freight, there was \$5114 - \$14, or \$5100 with which to buy goods and pay commission.

Since the agent receives for his services 2%, or $\frac{2}{100}$ of the sum expended for goods; and since \$5100 includes the sum expended for goods and the agent's commission, \$5100 must be $\frac{102}{100}$ of the sum expended for goods; therefore, since \$5100 is $\frac{51}{100}$ of \$5000, the value of the goods was \$5000.

36. Since the insurance is to cover the value of the goods and 3% of the sum for which the goods are to be insured, the value of the goods, or \$1940, is 100% - 3%, or 97%, or $\frac{97}{100}$ of the sum for which the goods must be insured; but since \$1940 is $\frac{97}{100}$ of \$2000, the goods must be insured for \$2000.

37. Since the man's income is 20%, or $\frac{1}{5}$ of his capital; and since he pays 3%, or $\frac{3}{100}$ of his income for taxes and insurance, he pays $\frac{3}{100}$ of $\frac{1}{5}$, or $\frac{3}{500}$ of his capital for taxes and insurance; but he pays \$150 for taxes and insurance; therefore, \$150 is $\frac{3}{500}$ of his capital; and since \$150 is $\frac{3}{500}$ of \$25,000, his capital is \$25,000.

38. Since A sold B a horse, which cost him \$160, at a profit of $12\frac{1}{2}\%$, or $\frac{1}{8}$ of the cost, he sold it for $\frac{9}{8}$ of \$160, or \$180; and since B sold it to C at a profit of 10%, or $\frac{1}{10}$ of what it cost him, he sold it for $\frac{11}{10}$ of \$180, or \$198.

Since the horse cost A \$160, if he had sold it to C for the price C paid, or \$198, he would have gained \$198 - \$160, or \$38; therefore, since \$38 is $\frac{38}{160}$, or $\frac{23\frac{1}{2}}{100}$ of \$160, A's profit would have been $23\frac{1}{2}\%$.

Page 147.

39. Since in the mixture there are 20 gallons of water and 120 gallons of milk, there are in all 140 gallons in the mixture; therefore, the water is $\frac{20}{140}$, or $\frac{14\frac{2}{7}}{100}$, or $14\frac{2}{7}\%$ of the mixture, and the milk is $100\% - 14\frac{2}{7}\%$, or $85\frac{5}{7}\%$ of the mixture.

40. Since $\frac{3}{4}$ of a barrel of sugar is sold for $\frac{4}{5}$ of the cost of a barrel, the gain is $\frac{4}{5} - \frac{3}{4}$, or $\frac{1}{20}$ of the cost of a barrel, and since $\frac{1}{20}$ is $\frac{1}{20}$ of $\frac{3}{4}$, the gain is $\frac{1}{15}$, or $\frac{6\frac{2}{3}}{100}$ of the cost; therefore, the rate of gain is $6\frac{2}{3}\%$.

41. Since the interest on the money invested in the house is 8% and the taxes and insurance amount to 4%, the actual cost of the house to me each year is 8% + 4%, or 12%, or $\frac{3}{25}$ of the money invested in the house, which is $\frac{3}{25}$ of \$4000, or \$480.

42. Since the rate of insurance was 2%, or $\frac{1}{50}$ of the sum for which the property was insured and the premium was \$48, $\frac{1}{50}$ of the sum for which the property was insured equals \$48; therefore, the property was insured for 50 times \$48, or \$2400.

Since the property was insured for $\frac{1}{4}$ of its value, \$2400 is $\frac{1}{4}$ of the value of the property, and since \$2400 is $\frac{1}{4}$ of \$3200, the value of the house and furniture was \$3200.

Since the furniture was worth $\frac{2}{3}$ as much as the house, the value of the furniture and the house was $\frac{5}{3}$ of the value of the house; therefore, \$3200 is $\frac{5}{3}$ of the value of the house, and since \$3200 is $\frac{2}{3}$ of \$2000, the value of the house was \$2000; consequently, the value of the furniture was $\frac{1}{3}$ of \$2000, or \$1200.

43. Since the time from July 15, 1896, to Oct. 30, 1897, is 1 yr. 3 mo. 15 da., the note was on interest 1 yr. 3 mo. 15 da. at 8%; and since the interest for 1 yr. 3 mo. 15 da. at 8% is $\frac{31}{300}$ of the principal, the amount for the same time and rate is $\frac{341}{300}$ of the principal; therefore, \$6620 is $\frac{341}{300}$ of the face of the note; and since \$6620 is $\frac{11}{10}$ of \$6000, the face of the note was \$6000.

44. Since the insolvent debtor was able to pay only 70 cents on the dollar, A lost 30 cents on the dollar, or $\frac{3}{10}$ of the debt owed him; and since he allowed 2% or $\frac{1}{50}$ of the debt for immediate payment, his total loss was $\frac{31}{50}$ of the debt owed him; therefore, since the insolvent debtor owed A \$6000, A's total loss was $\frac{31}{50}$ of \$6000, or \$1920.

45. Since the article is marked to gain 40%, or $\frac{2}{5}$ of the cost, it is marked to sell at $\frac{7}{5}$ of the cost; but since the salesman gives a discount of 10%, or $\frac{1}{10}$ of the marked price, he sells the article for $\frac{6}{5}$ of $\frac{7}{5}$, or $\frac{42}{25}$ of the cost.

Since a collector is paid 10%, or $\frac{1}{10}$ of the debt for collecting it, the merchant receives $\frac{9}{10}$ of the debt, or $\frac{9}{10}$ of $\frac{42}{25}$, or $\frac{378}{250}$ of the cost of the article; therefore, he gains $\frac{67}{500}$, or $\frac{13\frac{1}{2}}{100}$, or 13 $\frac{1}{2}$ %.

46. Since I ask for a horse 20%, or $\frac{1}{5}$ more than he cost me, my asking price is $\frac{6}{5}$ of the cost; and since I afterward make a deduction

of 10%, or $\frac{1}{10}$ from my asking price, I receive $\frac{9}{10}$ of $\frac{2}{3}$, or $\frac{2}{15}$ of the cost; but I receive \$162; therefore, \$162 is $\frac{2}{15}$ of the cost of the horse; and since \$162 is $\frac{2}{15}$ of \$150, the horse cost me \$150.

47. Since the man paid \$1200 for a farm and sold it for \$1300, he gained \$100 by the first transaction; since he bought the farm back for \$1500, the cost, by the second transaction, was \$300 more than the original cost; therefore, since he gained \$100 and afterward really lost \$300, his loss by the double transaction was \$200.

Since he lost \$200 on an original cost of \$1200, he lost $\frac{200}{1200}$, or $\frac{1}{6}$, or $\frac{16\frac{2}{3}}{100}$, or 16 $\frac{2}{3}$ % by the double transaction.

Page 148.

48. Since 10% of a number is $\frac{1}{10}$ of the number, the remainder is $\frac{9}{10}$ of the number and half the remainder is $\frac{1}{2}$ of $\frac{9}{10}$, or $\frac{9}{20}$ of the number; therefore, 5%, or $\frac{1}{20}$ of half the remainder is $\frac{1}{20}$ of $\frac{9}{20}$, or $\frac{9}{400}$ of the number; hence, the sum of 10% of a number and 5% of half the remainder is $\frac{1}{10} + \frac{9}{400}$, or $\frac{49}{400}$ of the number; and since a quarter of the number is $\frac{1}{4}$ of the number, the sum of 10% of a number and 5% of half the remainder is $\frac{49}{400}$ of a quarter of the number, or 49% of a quarter of the number.

49. Since the bicycle is listed at \$48 and bought at a discount of 10%, or $\frac{1}{10}$ of the list price, the cost is $\frac{9}{10}$ of \$48, or \$43.20; and since it is sold at 25%, or $\frac{1}{4}$ above the list price, the selling price is $\frac{5}{4}$ of \$48, or \$60.

Since a bicycle that cost \$43.20 is sold for \$60, the gain is \$60 — \$43.20, or \$16.80.

50. Since the agent charged 4% commission and \$34 expenses for selling a farm, and sent the owner \$1166, the sum of \$34 and \$1166, or \$1200, is 4% less than the selling price of the farm; therefore, \$1200 is 96%, or $\frac{24}{25}$ of the selling price of the farm; and since \$1200 is $\frac{24}{25}$ of \$1250, the selling price of the farm was \$1250.

51. Since the merchant makes a profit of 20%, or $\frac{1}{5}$ of the cost of his goods, he sells them for $\frac{6}{5}$ of their cost; and since he sells them at a deduction of 20%, or $\frac{1}{5}$ from the marked price, he sells them for $\frac{4}{5}$ of the marked price; therefore, $\frac{4}{5}$ of the marked price equals $\frac{6}{5}$ of the cost; $\frac{1}{5}$ of the marked price equals $\frac{1}{5}$ of $\frac{6}{5}$, or $\frac{6}{25}$ of the cost; and the marked price equals 5 times $\frac{6}{25}$, or $\frac{6}{5}$ of the cost; therefore, the goods are marked at an advance of $\frac{1}{5}$, or 20% on the cost.

52. Since A has gained $5\frac{1}{2}\%$, or $\frac{5\frac{1}{2}}{100}$, or $\frac{43}{800}$ of his investment, he has at the end of the year $\frac{43}{800}$ of \$4000, or \$4215; and since B has lost $4\frac{2}{3}\%$, or $\frac{4\frac{2}{3}}{100}$, or $\frac{22}{500}$ of his investment, he has at the end of the year $\frac{47}{500}$ of \$4000, or \$3824.

53. Since the farmer's crop of potatoes last year was 5%, or $\frac{1}{20}$ more than his crop this year, his crop last year was $\frac{21}{20}$ of his crop this year, and his crop both years was $\frac{20}{20} + \frac{21}{20}$, or $\frac{41}{20}$ of his crop this year; but since he raised 615 bushels in the two years, 615 bushels is $\frac{41}{20}$ of his crop this year; and since 615 is $\frac{1}{5}$ of 300, he raised 300 bushels this year.

54. Since the making cost 25%, or $\frac{1}{4}$ less than the cloth, it cost $\frac{3}{4}$ as much as the cloth; and since the trimmings cost 25%, or $\frac{1}{4}$ more than the cloth, they cost $\frac{5}{4}$ as much as the cloth; therefore, the cost of the cloth, the making, and the trimmings equals $\frac{3}{4} + \frac{3}{4} + \frac{5}{4}$, or $1\frac{1}{2}$ of the cost of the cloth, which is 3 times the cost of the cloth; but the entire cost was \$36; therefore, \$36 is 3 times the cost of the cloth, and the cloth cost $\frac{1}{3}$ of \$36, or \$12; since the making cost $\frac{3}{4}$ as much as the cloth, it cost $\frac{3}{4}$ of \$12, or \$9; and since the trimmings cost $\frac{5}{4}$ as much as the cloth they cost $\frac{5}{4}$ of \$12, or \$15.

55. Since the grocer realizes a profit of 20%, or $\frac{1}{5}$ of the cost, he receives for the goods $\frac{6}{5}$ of \$12,000, or \$14,400; and since 4% of the sales is allowed for bad debts, \$14,400 is 96%, or $\frac{24}{25}$ of the sum for which he sells the goods; and since \$14,400 is $\frac{24}{25}$ of \$15,000, he sells the goods for \$15,000.

56. Since the merchant charges 1% a month for overdue accounts, and Mr. Jones owes him an account of \$540, Mr. Jones will have to pay him $\frac{1}{100}$ of \$540, or \$5.40 for each month his account is overdue; and since his account is overdue 8 months, he will have to pay 8 times \$5.40, or \$43.20; therefore, to settle his account, Mr. Jones will have to pay \$540 + \$43.20, or \$583.20.

57. Since my store is valued at \$2500 and the goods at \$2000, the value of both is the sum of \$2500 and \$2000, or \$4500; and since I insure the whole property for $\frac{2}{3}$ of its value, I insure it for $\frac{2}{3}$ of \$4500, or \$3000.

Since I insure my property for \$3000 at $\frac{3}{4}\%$, my annual premium is $\frac{3}{4}\%$, or $\frac{3}{100}$ of \$3000, which is \$22 $\frac{1}{2}$.

Page 149.

58. Since the interest of any sum for 2 yr. 3 mo. and 18 da. at 6% is $\frac{9}{100}$ of the principal, and the amount for that time is $\frac{109}{100}$ of the principal, \$5690 is $\frac{109}{100}$ of the principal; $\frac{1}{5\frac{1}{5}}$ of the principal is $\frac{1}{5\frac{1}{5}}$ of \$5690, which is \$10; and the principal is 500 times \$10, or \$5000. Hence, to amount to \$6400 the principal would have to yield \$6400 - \$5000, or \$1400 interest.

Since in one year at 6% the interest on \$5000 is \$300, to yield \$1400 interest will require as many years as \$300 is contained times in \$1400, or $4\frac{2}{3}$ years.

59. Since the net income was \$500, there was \$500 left after the interest on the mortgage was paid; therefore, there was an income of \$500 on an investment of \$3000, or the income was $\frac{500}{3000}$, or $\frac{1}{6}$, or $16\frac{2}{3}\%$ of the investment; that is, the man obtained $16\frac{2}{3}\%$ interest on his investment.

60. Since the man drew out 25%, or $\frac{1}{4}$ of the money he had in a bank, there remained $\frac{3}{4}$ of it; and since he then drew out 50%, or $\frac{1}{2}$ of the remainder, he drew out a sum equal to $\frac{1}{2}$ of $\frac{3}{4}$, or $\frac{3}{8}$ of the sum he had in the bank at first; therefore, he drew out in all $\frac{1}{4} + \frac{3}{8}$, or $\frac{5}{8}$ of the sum he had in the bank at first, and there was left $\frac{3}{8}$ of that sum.

Since he then deposited 120%, or $\frac{6}{5}$ as much as he had drawn out, he deposited a sum equal to $\frac{6}{5}$ of $\frac{3}{8}$, or $\frac{9}{8}$ of what he had in the bank at first, and there was then in the bank a sum equal to $\frac{3}{8} + \frac{9}{8}$, or $\frac{12}{8}$ of the sum he had in the bank at first, which is $\frac{3}{2}$ of \$4800, or \$5400.

61. Since the merchant increased his capital 20%, or $\frac{1}{5}$ the first year, it was then $\frac{6}{5}$ of his original capital; since he increased this 25%, or $\frac{1}{4}$ the second year, it was then $\frac{7}{4}$ of $\frac{6}{5}$, or $\frac{21}{10}$ of the original capital; and since he increased his capital the third year 40%, or $\frac{2}{5}$ that of the previous year, it was then $\frac{7}{5}$ of $\frac{21}{10}$, or $\frac{49}{10}$ of his original capital; but he was then worth \$21,000; therefore, \$21,000 is $\frac{49}{10}$ of his original capital; and since \$21,000 is $\frac{49}{10}$ of \$10,000, he began with a capital of \$10,000.

62. Since 1 barrel of flour cost \$6, 50 barrels cost 50 times \$6, or \$300; therefore, to clear 8%, or $\frac{4}{25}$ on the cost of the whole quantity, the miller should receive $\frac{34}{25}$ of the cost, which is $\frac{34}{25}$ of \$300, or \$324.

Since 10 barrels were destroyed, there were 40 barrels to be sold for \$324; therefore, he should receive $\frac{8.10}{1}$ of \$324, or \$8.10 per barrel.

63. Since the widow received 40% of her husband's estate and her daughter 26% of it, the widow received $40\% - 26\%$, or 14% , or $\frac{7}{25}$ of

it more than the daughter received ; but the widow received \$4200 more than the daughter ; therefore, \$4200 is $\frac{7}{6}$ of the estate, and since \$4200 is $\frac{7}{6}$ of \$30,000, the value of the estate was \$30,000 ; since the widow received 40%, or $\frac{2}{5}$ of the estate, she received $\frac{2}{5}$ of \$30,000, or \$12,000 ; and since her daughter received 26%, or $\frac{13}{50}$ of the estate, she received $\frac{13}{50}$ of \$30,000, or \$7800.

64. Since the agent purchased \$4000 worth of goods on 5% commission, the commission for buying was $\frac{1}{20}$ of \$4000, or \$200 ; since the goods were sold at 5% less than first cost, there was a loss of $\frac{1}{20}$ of \$4000, or \$200, on the sale of the goods ; and since the goods were sold at a loss of \$200, they were sold for \$4000 - \$200, or \$3800 ; therefore, since the commission for selling was 5% of the sales, it was $\frac{1}{20}$ of \$3800, or \$190 ; hence, there was lost by the transaction \$200, commission for buying, \$200 on the sale of the goods, and \$190, commission for selling, which is \$200 + \$200 + \$190, or \$590.

MISCELLANEOUS PROBLEMS.

Page 150.

1. Since, if $\frac{1}{2}$ of A's money is increased by $\frac{2}{3}$ of his money the sum is \$5600, $\frac{1}{2} + \frac{2}{3}$, or $\frac{7}{6}$ of A's money equals \$5600 ; $\frac{1}{2}$ of his money equals $\frac{1}{2}$ of \$5600, or \$2800 ; and $\frac{2}{3}$, or all of his money, equals 6 times \$2800, or \$4800.

2. Since $\frac{1}{2}$ of the flock of sheep was sold at one time and $\frac{1}{4}$ of the remainder at another $\frac{3}{4}$ of $\frac{1}{2}$, or $\frac{3}{8}$ of the flock was sold the second time and in all there were sold $\frac{1}{2} + \frac{3}{8}$, or $\frac{7}{8}$ of the flock ; therefore, there were then left $\frac{1}{8}$ of the flock ; but there were left 50 sheep ; hence, $\frac{1}{8}$ of the flock equals 50 sheep ; consequently, there were 8 times 50 sheep, or 400 sheep at first.

3. Since $3\frac{1}{2}$ yards of ribbon cost 30 cents more than $2\frac{2}{3}$ yards, $3\frac{1}{2} - 2\frac{2}{3}$, or $\frac{5}{6}$ yd. cost 30 cents ; $\frac{1}{6}$ yd. cost $\frac{1}{5}$ of 30 cents, or 6 cents, and a yard cost 6 times 6 cents, or 36 cents.

4. Since $5\frac{1}{2}$ tons - $4\frac{1}{2}$ tons = $1\frac{1}{2}$ tons, when there is only $4\frac{1}{2}$ tons of coal left in his cellar the man has used $1\frac{1}{2}$ tons ; and since $1\frac{1}{2}$ tons is $\frac{1}{4}$ of $5\frac{1}{2}$ tons, $\frac{1}{4}$ of the coal has been used.

5. Since 10 eggs, or $\frac{1}{2}$ of a dozen, are sold for 25 cents, $\frac{1}{2}$ of a dozen are sold for $\frac{1}{2}$ of 25 cents, or 12 cents, and a dozen are sold for 6 times 12 cents, or 72 cents.

Since eggs are bought at 18 cents per dozen and sold at 30 cents per dozen, the gain per dozen is $30 - 18$, or 12 cents; therefore, as many dozen must be sold to gain \$12, or 1200 cents, as 12 cents is contained times in 1200 cents, or 100 dozen.

6. Since 3 lemons are worth 2 oranges, as many times 3 lemons are worth 20 oranges as 2 is contained times in 20, or 10 times 3 lemons, or 30 lemons are worth 20 oranges; and since 3 apples are worth 2 lemons, as many times 3 apples are worth 30 lemons as 2 is contained times in 30, or 15 times 3 apples, or 45 apples are worth 30 lemons; therefore, since 45 apples are worth 30 lemons and 30 lemons are worth 20 oranges, 45 apples are worth 20 oranges.

7. Since $\frac{1}{4}$ of a ton of hay lasts the horse $\frac{1}{2}$ a month; and since $1\frac{1}{2}$ tons is $\frac{3}{2}$ of $\frac{1}{2}$ of a ton, $1\frac{1}{2}$ tons will last the horse $\frac{3}{2}$ of $\frac{1}{2}$ of a month, or $\frac{3}{4}$ of a month.

8. Since $\frac{2}{3}$ of $\frac{1}{2}$, or $\frac{1}{3}$ of A's money is equal to twice B's, all of A's money is equal to 4 times B's; therefore, the difference between A's money and B's money is 3 times B's money; but A has \$5000 more than B; therefore, \$5000 is 3 times B's money; hence, B has $\frac{1}{3}$ of \$5000, or \$1666 $\frac{2}{3}$; consequently, A has \$1666 $\frac{2}{3}$ + \$5000, or \$6666 $\frac{2}{3}$.

9. Since A sold B $\frac{2}{3}$ of his land, A then had left $\frac{1}{3}$ of the land; and since A bought back $\frac{1}{4}$ of what he had sold, he bought back $\frac{1}{4}$ of $\frac{2}{3}$, or $\frac{1}{6}$ of the land; hence A then had $\frac{1}{3} + \frac{1}{6}$, or $\frac{1}{2}$ of the land; consequently, B had $\frac{1}{2}$ of the land.

Page 151.

10. Since the man can walk 3 miles per hour it will take him as many hours to walk 9 miles as 3 is contained times in 9, or 3 hours.

Since it requires 1 hour for him to ride 9 miles from home on a bicycle and 3 hours for him to walk back that distance, it requires 4 hours for him to go 9 miles and return, if he rides going and walks back; therefore, in 9 hours he can go and return as many times 9 miles as 4 hours are contained times in 9 hours, or $2\frac{1}{4}$ times 9 miles, which is $20\frac{1}{4}$ miles.

11. Since $\frac{2}{3}$ of a pound of pork costs as much as $\frac{1}{2}$ a pound of beef, $\frac{1}{4}$ of a pound of pork costs as much as $\frac{1}{3}$ of $\frac{1}{2}$, or $\frac{1}{6}$ of a pound of beef, and a pound of pork costs 4 times as much as $\frac{1}{4}$ of a pound of beef, or as much as $\frac{2}{3}$ of a pound of beef; therefore, 3 pounds of pork cost 3 times as much as $\frac{2}{3}$ of a pound of beef, or as much as 2 pounds of beef; hence, 3 pounds of pork and 4 pounds of beef together cost as much as

2 pounds of beef and 4 pounds of beef, or 6 pounds of beef; but 3 pounds of pork and 4 pounds of beef together cost 99 cents; therefore, 6 pounds of beef cost 99 cents, and 1 pound costs $\frac{1}{6}$ of 99 cents, or $16\frac{1}{2}$ cents; and since 1 pound of pork costs as much as $\frac{2}{3}$ of a pound of beef, 1 pound of pork costs $\frac{2}{3}$ of $16\frac{1}{2}$ cents, or 11 cents.

12. Since 3 men can do a piece of work in 8 days, 1 man could do the work in 3 times 8 days, or 24 days; therefore, to do the work in 6 days it will require as many men as 6 is contained times in 24, or 4 men.

13. Since one pipe can fill a cistern in 4 hours, it can fill $\frac{1}{4}$ of the cistern in 1 hour; and since a second pipe can fill the cistern in 6 hours, it can fill $\frac{1}{6}$ of the cistern in 1 hour; therefore, both pipes running together can fill $\frac{1}{4} + \frac{1}{6}$, or $\frac{5}{12}$ of the cistern; hence, they will require as many hours to fill the cistern as $\frac{5}{12}$ is contained times in $1\frac{1}{2}$, or $2\frac{2}{5}$ hours.

14. Since the seamstress can make a dress in 3 days, in 1 day she can do $\frac{1}{3}$ of the work necessary to make a dress; and since with the assistance of her sister she can make it in 2 days, in 1 day they can together do $\frac{1}{2}$ of the work necessary to make the dress; therefore, in 1 day the sister can do $\frac{1}{2} - \frac{1}{3}$, or $\frac{1}{6}$ of the work necessary to make a dress; consequently, she can make the dress in 6 days.

15. Since 1 pound of the first kind of coffee is worth 27 cents, 6 pounds are worth 6 times 27 cents, or 162 cents; and since 1 pound of the second kind of coffee is worth 19 cents, 2 pounds are worth 2 times 19 cents, or 38 cents; therefore, the mixture of 6 pounds of the first kind and 2 pounds of the second kind, or 8 pounds, is worth 162 cents plus 38 cents, or 200 cents.

Since 8 pounds of the mixture are worth 200 cents, the mixture is worth $\frac{1}{8}$ of 200 cents, or 25 cents per pound.

16. Since the clock gains 5 minutes an hour, at any time after it is set right it indicates $\frac{5}{60}$, or $\frac{1}{12}$ of the correct time; therefore, when the clock indicates 5 o'clock in the afternoon, or 5 hours past noon, it indicates $\frac{1}{12}$ of the correct number of hours past noon; and since 5 hours is $\frac{1}{12}$ of $4\frac{1}{3}$ hours, the correct time is $4\frac{1}{3}$ hours past noon, or since $\frac{1}{12}$ of an hour equals $36\frac{1}{2}$ minutes, the correct time is $36\frac{1}{2}$ minutes past 4 o'clock in the afternoon.

17. Since $\frac{2}{3}$ of a pound of cheese costs 2 cents more than $\frac{1}{4}$ of a pound of butter at twice as much per pound; and since at twice as much per pound $\frac{1}{4}$ of a pound of butter costs as much as 2 times $\frac{1}{4}$, or

$\frac{1}{2}$ of a pound of cheese, $\frac{2}{3}$ of a pound of cheese costs 2 cents more than $\frac{1}{2}$ of a pound of cheese; therefore, $\frac{2}{3} - \frac{1}{2}$, or $\frac{1}{6}$ of a pound of cheese costs 2 cents, and a pound of cheese costs 6 times 2 cents, or 12 cents; hence, a pound of butter costs 2 times 12 cents, or 24 cents.

18. Since for every 2 miles that I can walk, I can go 9 miles on a bicycle; and since in a journey of 60 miles I walk three times as long as I ride, I walk 3 times 2 miles, or 6 miles, for every 9 miles that I ride, or I walk 6 miles for every 15 miles that I go; therefore, since 15 miles are contained in 60 miles 4 times, in a journey of 60 miles I walk 4 times 6 miles, or 24 miles; consequently, I travel by bicycle 60 - 24, or 36 miles.

Page 152.

20. Since there were 20 animals, if they had all been sheep they would have cost 20 times \$6, or \$120.

Since this cost is reduced \$6 - \$2, or \$4 for every lamb bought, and since the total reduction is \$120 - \$100, or \$20, there were as many lambs as \$4 is contained times in \$20, or 5 lambs; consequently, there were 20 - 5, or 15 sheep.

21. Since the whole number of days worked was 30, if the father had done the whole 30 days' work the total wages would have been 30 times \$3, or \$90.

Since this sum is reduced \$3 - \$1, or \$2 for every day the son worked, and since the total reduction is \$90 - \$70, or \$20, the son worked as many days as \$2 is contained times in \$20, or 10 days; consequently, the father worked 30 - 10, or 20 days.

22. Since the merchant bought 60 barrels of flour, if they had all been of the better quality, they would have cost 60 times \$6, or \$360.

Since this cost is reduced \$6 - \$5, or \$1 for every barrel of the inferior quality bought, and since the total reduction is \$360 - \$340, or \$20, the merchant bought 20 barrels of the inferior quality; consequently, he bought 60 - 20, or 40 barrels of the better quality of flour.

23. Since the farmer sold 100 fowl, if they had all been turkeys he would have received 100 times 80 cents, or \$80.

Since this sum is reduced 80 - 50, or 30 cents, or $\frac{3}{10}$ for every chicken he sold, and since the total reduction is \$80 - \$68, or \$12, there were as many chickens as $\frac{3}{10}$ is contained times in \$12, or 40 chickens; consequently, there were 100 - 40, or 60 turkeys.

24. Since the man employed a certain number of men at $\$2\frac{1}{2}$ per day and the same number of boys at $\$1\frac{1}{2}$ per day, he paid to a man and a boy the sum of $\$2\frac{1}{2}$ and $\$1\frac{1}{2}$, or $\$3\frac{1}{2}$ each day; and since the daily pay of all amounted to $\$39$, there were as many men, or as many boys, as $\$3\frac{1}{2}$ is contained times in $\$39$; that is, there were 12 men and 12 boys.

25. Since the man agreed to work 30 days at $\$4$ per day, if he had worked every day he would have received 30 times $\$4$, or $\$120$.

Since for every day he was idle he lost the sum of his wages, $\$4$, and a forfeit of $\$2$, or $\$6$ in all, and since his total loss was $\$120 - \90 , or $\$30$, he was idle as many days as $\$6$ is contained times in $\$30$, or 5 days; consequently, he worked $30 - 5$, or 25 days.

Page 153.

26. Since the man agreed to work 18 days at $\$3\frac{1}{2}$ per day, if he had worked every day he would have received 18 times $\$3\frac{1}{2}$, or $\$63$.

Since for every day he was idle he lost the sum of his wages, $\$3\frac{1}{2}$, and the cost of his board, $\$1\frac{1}{2}$, or $\$5$ in all, and since his total loss was $\$63 - \43 , or $\$20$, he was idle as many days as $\$5$ is contained times in $\$20$, or 4 days; consequently, he worked $18 - 4$, or 14 days.

27. Since the employer hires 5 more men than he had at first at $\$3$ per day, his expenses are increased 5 times $\$3$, or $\$15$, per day on account of employing an additional number of men; and since his expenses are increased the total amount of $\$25$ per day, the increase due to raising the wages of the workmen he had at first is $\$25 - \15 , or $\$10$ per day.

Since he increased their wages from $\$2\frac{1}{2}$ per day to $\$3$ per day, the increase for one man was $\$1\frac{1}{2}$ per day; therefore, he had as many workmen at first as $\$1\frac{1}{2}$ is contained in $\$10$, or 20 workmen.

28. Since the contractor discharged 10 of his men who had been working at $\$3$ per day, he reduced his expenses 10 times $\$3$, or $\$30$ per day by employing a less number of men than he had at first; but since he reduced his expenses in all $\$50$ per day, $\$50 - \30 , or $\$20$ per day is the reduction due to reducing the wages of the men he retained.

Since he reduced their wages from $\$3$ per day to $\$2\frac{1}{2}$ per day, the reduction for one man was $\$1\frac{1}{2}$ per day; therefore, he retained as many men as $\$1\frac{1}{2}$ is contained times in $\$20$, or 40 men.

Since he discharged 10 men and retained 40 men, he had at first the sum of 10 men and 40 men, or 50 men.

29. Since the farmer received 60 cents a bushel for wheat and 40 cents a bushel for rye, he received 20 cents, or $\$ \frac{1}{5}$, more for a bushel of wheat than for a bushel of rye; therefore, since he sold equal quantities of wheat and rye and received $\$6$ more for wheat than for rye, he sold as many bushels of wheat as $\$ \frac{1}{5}$ is contained times in $\$6$, or 30 bushels of wheat; consequently, since he sold an equal quantity of rye he sold 30 bushels of rye.

31. Since the boy lost 5 more than $\frac{1}{2}$ his marbles and later lost 5 more than $\frac{1}{2}$ the remainder and then had left 5 marbles, if, the second time, he had lost only $\frac{1}{2}$ of the remainder he would have had left 10 marbles; hence, he had 2 times 10 marbles, or 20 marbles, before he lost the second time.

Since, the first time, he lost 5 more than $\frac{1}{2}$ his marbles and had left 20 marbles, if he had lost only $\frac{1}{2}$ his marbles he would have had left 25 marbles; hence, he had at first 2 times 25 marbles, or 50 marbles.

Page 154.

32. Since the poulturer sold 12 less than $\frac{1}{3}$ of his chickens and had 72 left, if he had sold $\frac{1}{3}$ of his chickens, he would have had left 60 chickens; but he would have had left $\frac{2}{3}$ of his chickens; therefore, $\frac{2}{3}$ of his chickens equals 60; $\frac{1}{3}$ of them equals $\frac{1}{2}$ of 60, or 30; and he had at first 3 times 30 chickens, or 90 chickens.

33. Since the farmer sold 5 bushels more than $\frac{1}{3}$ of his load of potatoes to one man and 10 bushels more than $\frac{1}{3}$ of the remainder to another man and then had 8 bushels left, if he had sold only $\frac{1}{3}$ of the remainder to the second man, he would have had 18 bushels left; and since he would have had $\frac{2}{3}$ of the remainder left, 18 bushels is $\frac{2}{3}$ of the remainder, or $\frac{2}{3}$ of the number of bushels he had left after he made his first sale; therefore, since 18 bushels is $\frac{2}{3}$ of 27 bushels, he had left 27 bushels after he had made his first sale.

Since he sold 5 bushels more than $\frac{1}{3}$ of his load of potatoes to the first man and had left 27 bushels, if he had sold only $\frac{1}{3}$ of his load, he would have had left 32 bushels; and since he would have had left $\frac{2}{3}$ of his load, 32 bushels is $\frac{2}{3}$ of his load; therefore, since 32 bushels is $\frac{2}{3}$ of 48 bushels, he had 48 bushels in his load.

34. Since the boy gave 3 less than $\frac{1}{3}$ of his marbles to his brother and 2 less than $\frac{1}{3}$ of the remainder to a playmate and had 16 left, if he

had given just $\frac{1}{3}$ of the remainder to his playmate he would have had left only 14 marbles; and since he would have had left $\frac{2}{3}$ of the remainder, $\frac{2}{3}$ of the remainder equals 14 marbles; therefore, since 14 is $\frac{2}{3}$ of 21, he had 21 marbles before he gave any to his playmate.

Since he gave 3 less than $\frac{1}{3}$ of his marbles to his brother and then had 21 marbles left, if he had given just $\frac{1}{3}$ of his marbles to his brother he would have had left 18 marbles; and since he would have had left $\frac{2}{3}$ of what he had at first, $\frac{2}{3}$ of the marbles he had at first equals 18 marbles; therefore, since 18 marbles is $\frac{2}{3}$ of 27 marbles, he had 27 marbles at first.

35. Since I paid my grocer \$20 more than $\frac{2}{3}$ of what I owed him and still owed him \$40, if I had paid him only $\frac{2}{3}$ of what I owed him, I would still owe him \$60; and since I would still owe him $\frac{2}{3}$ of what I owed him at first, \$60 is $\frac{2}{3}$ of what I owed him at first; therefore, since \$60 is $\frac{2}{3}$ of \$100, I owed him \$100 at first.

36. Since the lady paid for the cloak \$20 more than $\frac{2}{3}$ of her money and had \$80 left, if she had paid only $\frac{2}{3}$ of her money she would have had left \$100; and since she would have had left $\frac{1}{3}$ of her money, \$100 is $\frac{1}{3}$ of her money; therefore, since \$100 is $\frac{1}{3}$ of \$140, she had at first \$140.

Since she paid for the cloak \$20 more than $\frac{2}{3}$ of her money, the cloak cost the sum of $\frac{2}{3}$ of \$140, or \$40, and \$20, which is \$60.

37. Since the girl cut from the piece of ribbon $\frac{1}{3}$ of a yard less than $\frac{1}{3}$ of it and then had 2 yards left, if she had cut off exactly $\frac{1}{3}$ of the piece she would have had left $1\frac{2}{3}$ yards; and since she would have had left $\frac{2}{3}$ of the piece, $1\frac{2}{3}$ yards is $\frac{2}{3}$ of the piece; therefore, since $1\frac{2}{3}$ yards is $\frac{2}{3}$ of $2\frac{2}{3}$ yards, there were $2\frac{2}{3}$ yards in the piece at first.

38. Since after 30 feet had been broken from the top of a flagpole there remained standing 10 feet more than $\frac{2}{3}$ of the pole, if only $\frac{2}{3}$ of the pole had remained standing 40 feet would have been broken off; and since $\frac{2}{3}$ would have been broken off, 40 feet is $\frac{2}{3}$ of the length of the pole at first; therefore, since 40 feet is $\frac{2}{3}$ of 100 feet, the pole was 100 feet long at first.

39. Since the boy paid 25 cents less than $\frac{1}{2}$ his money for a pair of shoes and 25 cents more than $\frac{1}{2}$ the remainder for a hat and had 75 cents left, if he had paid only $\frac{1}{2}$ of the remainder for a hat, he would have had left \$1; hence, he had 2 times \$1, or \$2, left after buying the shoes.

Since he paid 25 cents less than $\frac{1}{2}$ his money for a pair of shoes and had \$2 left, if he had paid $\frac{1}{2}$ his money for the shoes he would have had left \$1 $\frac{1}{2}$; hence, he had at first 2 times \$1 $\frac{1}{2}$, or \$3 $\frac{1}{2}$.

40. Since the man paid me \$20 more than $\frac{2}{3}$ of what he owed me and soon after paid me $\frac{2}{3}$ of the remainder but still owed me \$40, he still owed me $\frac{2}{3}$ of the remainder; therefore, \$40 is $\frac{2}{3}$ of what he owed me after making the first payment; and since \$40 is $\frac{2}{3}$ of \$100, he still owed me \$100 after making the first payment.

Since at first he paid me \$20 more than $\frac{2}{3}$ of what he owed me, but still owed me \$100, if he had paid me only $\frac{2}{3}$ of what he owed me he would still have owed me \$120; and since he would still have owed me $\frac{2}{3}$ of what he owed me at first, \$120 is $\frac{2}{3}$ of what he owed me at first; therefore, since \$120 is $\frac{2}{3}$ of \$200, he owed me \$200 at first.

Page 155.

42. Since in going downstream the man's rate is increased by the rate of the current and in returning his rate is diminished by that of the current, his rate down exceeds his rate up by twice the rate of the current; that is, 12 miles less 6 miles, or 6 miles per hour is twice the rate of the current; therefore, the rate of the current is $\frac{1}{2}$ of 6 miles, or 3 miles per hour.

Since his rate going downstream is 12 miles per hour and the rate of the current is 3 miles per hour, his rate in still water is 12 miles less 3 miles, or 9 miles per hour.

43. Since the boatman's rate down a river was $1\frac{1}{2}$ times his rate returning, for every mile he could go up the river in 1 hour, he could go $1\frac{1}{2}$ miles, or $\frac{3}{2}$ miles, down the river in 1 hour; therefore, since the distance he rowed down equals the distance he rowed back, for every hour it took him in returning it took him $\frac{2}{3}$ of an hour in going, and $1\frac{2}{3}$ hours in going and returning; hence, since the round trip occupied him $7\frac{1}{2}$ hours, he was as many hours returning as $1\frac{2}{3}$ is contained times in $7\frac{1}{2}$, or $4\frac{1}{2}$ hours.

44. Since the man rides away from home at the rate of 6 miles an hour, he rides away 1 mile in $\frac{1}{6}$ of an hour; and since he returns at the rate of 3 miles an hour, he returns 1 mile in $\frac{1}{3}$ of an hour; therefore, since he rides away 1 mile in $\frac{1}{6}$ of an hour and returns 1 mile in $\frac{1}{3}$ of an hour, it will take him $\frac{1}{6} + \frac{1}{3}$, or $\frac{1}{2}$ of an hour to go 1 mile and return.

45. Since he returns at the rate of 6 miles an hour, it will require as many hours for him to return 8 miles as 6 miles is contained times in 8 miles, or $1\frac{1}{3}$ hours; therefore, since he travels away at the rate of 8 miles an hour, it will require $2\frac{1}{2}$ hours for him to travel 8 miles and return; hence, in 7 hours he can travel and return as many times 8 miles as $2\frac{1}{2}$ hours is contained times in 7 hours, or 3 times 8 miles, which is 24 miles.

46. Since the rate of returning is 5 miles an hour, it will require as many hours for one to return 10 miles as 5 miles is contained times in 10 miles, or 2 hours; therefore, to go downstream 10 miles and return will require 3 hours; hence, in 6 hours one can go downstream and return as many times 10 miles as 3 hours is contained times in 6 hours, or 2 times 10 miles, which is 20 miles.

47. Since the man drove back at the rate of 10 miles an hour, it required as many hours for him to drive back 20 miles as 10 miles is contained times in 20 miles, or 2 hours; therefore, since he went away at the rate of 20 miles an hour and drove back at the rate of 20 miles in 2 hours, it required 3 hours for him to go 20 miles and return; hence in 9 hours he went and returned as many times 20 miles as 3 hours is contained times in 9 hours, or 3 times 20 miles, which is 60 miles.

48. Since his rate in returning is but $\frac{3}{4}$ of his rate going, he will require $\frac{4}{3}$ as much time in returning as in going; therefore, in going and returning he will require $\frac{7}{3}$ as much time as in going; but he can take a trip of 36 miles and return in 10 hours; hence, 10 hours is $\frac{3}{7}$ of the time it will take him to go, and since 10 hours is $\frac{5}{12}$ of 4 hours, it will take him 4 hours to go; consequently, it will take him 6 hours to return. Hence, his rate per hour returning is $\frac{1}{6}$ of 36 miles, or 6 miles.

Page 156.

49. Since the man's salary is $1\frac{1}{2}$ times his expenses, he saves a sum equal to $\frac{1}{2}$ of his expenses; but he saves \$3000 in 10 years, or $\frac{1}{10}$ of \$3000, which is \$300, in 1 year; therefore, \$300 is $\frac{1}{2}$ of his expenses for 1 year; hence, his expenses are 4 times \$300, or \$1200 annually.

Since his expenses are \$1200 annually, and his salary is $1\frac{1}{2}$ times his expenses, his salary is $1\frac{1}{2}$ times \$1200, or \$1500.

50. Since the lady paid 10 cents a yard for one piece of dress goods and 15 cents a yard for the other, and since she paid the same amount

for each of the two pieces, for every yard she bought of the better kind she bought as many yards of the poorer kind as 10 is contained times in 15, or $1\frac{1}{2}$ yards of the poorer kind, and $2\frac{1}{2}$ yards of both; since she bought 20 yards in all, she bought as many yards of the better kind as $2\frac{1}{2}$ is contained times in 20, or 8 yards; consequently, the better piece cost 8 times 15 cents, or \$1.20; and since she paid the same amount for each of the two pieces, the poorer piece cost \$1.20, and for both she paid \$1.20 + \$1.20, or \$2.40.

51. Since one piece of meat was worth 12 cents a pound and the other 18 cents a pound, and since the two pieces were sold for the same sum, for every pound of the better kind sold there were sold as many pounds of the poorer kind as 12 cents is contained times in 18 cents, or $1\frac{1}{2}$ pounds of the poorer kind, and $2\frac{1}{2}$ pounds of both; since there were 20 pounds in both pieces, there were as many pounds in the better piece as $2\frac{1}{2}$ is contained times in 20, or 8 pounds; consequently, the other piece weighed $20 - 8$, or 12 pounds.

52. Since the man can ride in a coach at the rate of $12\frac{1}{2}$ miles an hour and walk back at the rate of $3\frac{1}{2}$ miles an hour, it will take him as many hours to walk back as far as he can ride in 1 hour as $3\frac{1}{2}$ is contained times in $12\frac{1}{2}$, or $3\frac{2}{5}$ hours; hence, to ride $12\frac{1}{2}$ miles and walk back will require $1 + 3\frac{2}{5}$, or $4\frac{2}{5}$ hours; therefore, in $9\frac{1}{2}$ hours the man can ride and walk back as many times $12\frac{1}{2}$ miles as $4\frac{2}{5}$ hours is contained times in $9\frac{1}{2}$ hours, or 2 times $12\frac{1}{2}$ miles, which is 25 miles.

53. Since the steamer goes down a river at the rate of 12 miles an hour and returns at the rate of 8 miles an hour, the time going is $\frac{2}{3}$, or $\frac{2}{3}$ of the time returning, or $\frac{1}{3}$ less than the time returning; but the time going is $2\frac{1}{2}$ hours less than the time returning; therefore, $2\frac{1}{2}$ hours is $\frac{1}{3}$ of the time returning; and since $2\frac{1}{2}$ hours is $\frac{1}{3}$ of $7\frac{1}{2}$ hours, the time returning is $7\frac{1}{2}$ hours; consequently, the time going is $7\frac{1}{2}$ hours - $2\frac{1}{2}$ hours, or 5 hours.

Since the time going is 5 hours, and the rate 12 miles an hour, the steamer goes 5 times 12 miles, or 60 miles.

54. Since the man's business occupied him $1\frac{1}{2}$ hours, and he was gone in all 7 hours, the time occupied in going and returning was 7 hours - $1\frac{1}{2}$ hours, or $5\frac{1}{2}$ hours.

Since his rate going was $8\frac{1}{2}$ miles per hour, and his rate returning was 5 miles per hour, it would take him as many hours to return the distance he could go in 1 hour as 5 is contained times in $8\frac{1}{2}$, or $1\frac{7}{10}$ hours; therefore, to drive $8\frac{1}{2}$ miles and return would take him $1 + 1\frac{7}{10}$,

or $2\frac{7}{10}$ hours; and since it took him $5\frac{1}{2}$ hours to drive to town and return, he lived as many times $8\frac{1}{2}$ miles from town as $2\frac{7}{10}$ hours is contained times in $5\frac{1}{2}$ hours, or 2 times $8\frac{1}{2}$ miles, which is 17 miles.

Page 157.

56. Since 9 months is $\frac{3}{4}$ of a year, in 9 months the man had earned $\frac{3}{4}$ of \$400, or \$300, and $\frac{3}{4}$ of the value of the horse; since he received \$260 and the horse, \$300 - \$260, or \$40, was allowed as the other fourth of the value of the horse; consequently, the value of the horse was 4 times \$40, or \$160.

57. Since the father and his son were to receive \$600 for a year's work, but in consequence of the son not working 2 months, or $\frac{1}{6}$ of the year, they received only \$575, the son was paid at the rate of \$600 - \$575, or \$25, for $\frac{1}{6}$ of a year, and 6 times \$25, or \$150 per year; hence, the father was paid at the rate of \$600 - \$150, or \$450 per year.

58. Since $9\frac{1}{2}$ months is $\frac{13}{12}$ of a year, in $9\frac{1}{2}$ months the man had earned $\frac{13}{12}$ of \$720, or \$570, and $\frac{13}{12}$ of 48 bushels of wheat, or 38 bushels of wheat; but he received \$540 and 68 bushels of wheat; therefore, instead of \$570 - \$540, or \$30, he received 68 - 38, or 30 bushels of wheat; hence, the wheat was worth a dollar per bushel.

59. Since 9 months is $\frac{3}{4}$ of a year, in 9 months the man had earned $\frac{3}{4}$ of \$800, or \$600, and $\frac{3}{4}$ of 100 bushels of potatoes, or 75 bushels of potatoes; but he received \$620 and 50 bushels of potatoes; therefore, instead of 75 - 50, or 25 bushels of potatoes, he received \$620 - \$600, or \$20; hence, the potatoes were worth $\frac{1}{5}$ of \$20, or \$4, or 80 cents per bushel.

61. Since 2 of B's steps are equal to 3 of A's, 1 of B's is equal to $\frac{3}{2}$ of A's, and 3 of B's are equal to $4\frac{1}{2}$ of A's; therefore, since A takes 4 steps while B takes 3, in taking 3 steps B gains $4\frac{1}{2} - 4$, or $\frac{1}{2}$ of one of A's steps; consequently, to gain 12 of A's steps B must take as many times 3 steps as $\frac{1}{2}$ is contained times in 12, or 24 times 3 steps, which is 72 steps.

62. Since 3 of B's steps are equal to 4 of A's, 1 of B's is equal to $\frac{4}{3}$ of A's, and 4 of B's are equal to $5\frac{1}{3}$ of A's; therefore, since A takes 5 steps while B takes 4, in taking 4 steps B gains $5\frac{1}{3} - 5$, or $\frac{1}{3}$ of one of A's steps; consequently, to gain 8 of A's steps B must take as many times 4 steps as $\frac{1}{3}$ is contained times in 8, or 24 times 4 steps, which is 96 steps.

Page 158.

63. Since 3 of the officer's steps are equal to 4 of the thief's, 1 of the officer's is equal to $\frac{4}{3}$ of one of the thief's, and 5 of the officer's are equal to $6\frac{2}{3}$ of the thief's; therefore, since the thief takes 6 steps while the officer takes 5, in taking 5 steps the officer gains $6\frac{2}{3} - 6$, or $\frac{2}{3}$ of one of the thief's steps; consequently, to gain 20 of the thief's steps the officer must take as many times 5 steps as $\frac{2}{3}$ is contained times in 20, or 30 times 5 steps, which is 150 steps.

65. Since 2 bushels of onions and 3 bushels of potatoes cost \$12, 6 bushels of onions and 9 bushels of potatoes cost \$36; and since 3 bushels of onions and 4 bushels of potatoes cost \$17, 6 bushels of onions and 8 bushels of potatoes cost \$34. Hence, $9 - 8$, or 1 bushel of potatoes costs $\$36 - \34 , or \$2.

Since 2 bushels of onions and 3 bushels of potatoes cost \$12, and 3 bushels of potatoes cost 3 times \$2, or \$6, 2 bushels of onions cost $\$12 - \6 , or \$6; therefore, 1 bushel of onions cost $\frac{1}{2}$ of \$6, or \$3.

66. Since $\frac{1}{2}$ of A's weekly wages and all of B's amount to \$17, all of A's and twice B's amount to \$34; and since all of A's and $\frac{1}{2}$ of B's amount to \$16, $1\frac{1}{2}$ times B's amount to $\$34 - \16 , or \$18; therefore, since \$18 is $1\frac{1}{2}$ times \$12, B's wages amount to \$12 per week.

Since $\frac{1}{2}$ of A's weekly wages and all of B's amount to \$17, and since all of B's amount to \$12, $\frac{1}{2}$ of A's amount to $\$17 - \12 , or \$5; therefore, A's wages amount to 2 times \$5, or \$10 per week.

67. Since if the boy works 1 day and his sister 1 day they together earn \$1.30, if the boy works 5 days and his sister 5 days they together earn 5 times \$1.30, or \$6.50; since the boy working 5 days and his sister working 4 days together earn \$6, his sister working $5 - 4$, or 1 day earns $\$6.50 - \6 , or \$.50.

Since they together earn \$1.30 a day and his sister earns \$.50 a day, the boy earns $\$1.30 - \$.50$, or \$.80 a day.

Page 159.

69. When it is 1 o'clock the hands of a clock are 5 minute spaces apart and the minute hand must gain 5 minute spaces to overtake the hour hand; since the minute hand gains on the hour hand 11 spaces in every 12 passed over, to gain one space it must move over $\frac{12}{11}$ spaces, and to gain 5 spaces it must move over 5 times $\frac{12}{11}$ spaces, or $5\frac{10}{11}$ spaces. Hence, the hands are together at $5\frac{10}{11}$ minutes after 1 o'clock.

70. When it is 4 o'clock the hands of a clock are 20 minute spaces apart and the minute hand must gain 20 minute spaces to overtake the hour hand ; since the minute hand gains on the hour hand 11 spaces in every 12 passed over, to gain one space it must move over $\frac{12}{11}$ spaces, and to gain 20 spaces it must move over 20 times $\frac{12}{11}$ spaces, or $21\frac{2}{11}$ spaces. Hence, when the hands of a clock are together between 4 and 5 o'clock, the time is $21\frac{2}{11}$ minutes past 4 o'clock.

71. Since at 4 o'clock the minute hand is 20 minute spaces behind the hour hand, in order that it may be 20 minute spaces ahead of the hour hand it must gain 40 minute spaces on the hour hand ; since the minute hand gains on the hour hand 11 spaces in every 12 passed over, to gain 1 space it must move over $\frac{12}{11}$ spaces, and to gain 40 spaces it must move over 40 times $\frac{12}{11}$ spaces, or $43\frac{7}{11}$ spaces. Hence, the minute hand will be 20 minute spaces ahead of the hour hand at $43\frac{7}{11}$ minutes past 4 o'clock.

72. When it is 8 o'clock the hands of a clock are 40 minute spaces apart and the minute hand must gain 40 minute spaces to overtake the hour hand ; since the minute hand gains on the hour hand 11 spaces in every 12 passed over, to gain 1 space it must move over $\frac{12}{11}$ spaces, and to gain 40 spaces it must move over 40 times $\frac{12}{11}$ spaces, or $43\frac{7}{11}$ spaces. Hence, the hands of a clock are together for the first time after 8 o'clock at $43\frac{7}{11}$ minutes past 8 o'clock.

73. Since A walks 5 rods while B walks 3 rods, A gains 2 rods for every 5 he walks ; therefore, to gain 1 rod A must walk $\frac{5}{2}$ rods and to gain 20 rods he must walk 20 times $\frac{5}{2}$ rods, or 50 rods. Hence, A will overtake B 50 rods from the starting point.

74. When it is 3 o'clock the hands of a clock are 15 minute spaces apart, and in order that they may point in opposite directions the minute hand must overtake the hour hand and then get 30 minute spaces ahead of the hour hand, or gain in all 45 minute spaces ; since the minute hand gains on the hour hand 11 spaces in every 12 passed over, to gain one space it must move over $\frac{12}{11}$ spaces, and to gain 45 spaces it must move over 45 times $\frac{12}{11}$ spaces, or $49\frac{1}{11}$ spaces. Hence, the hands of a clock point in opposite directions between 3 and 4 o'clock at $49\frac{1}{11}$ minutes after 3 o'clock.

76. Since $\frac{1}{2}$ of the time past noon is equal to $\frac{1}{3}$ of the time to midnight, the time past noon is equal to $\frac{2}{3}$ of the time to midnight and $\frac{2}{3}$ of the time to midnight equals the time from noon to midnight, which is 12 hours ; consequently, $\frac{1}{3}$ of the time to midnight is $\frac{1}{2}$ hours, and the

time to midnight is 3 times $\frac{1}{2}$ hours, or $7\frac{1}{2}$ hours. Hence, the time past noon is 12 hours — $7\frac{1}{2}$ hours, or $4\frac{1}{2}$ hours ; that is, the time is 48 minutes past 4 o'clock P.M.

77. Since $\frac{1}{4}$ of the time past noon is equal to $\frac{1}{2}$ of the time to midnight, the time past noon is equal to $\frac{2}{3}$ of the time to midnight, and $\frac{2}{3}$ of the time to midnight equals the time from noon to midnight, which is 12 hours ; consequently, $\frac{1}{3}$ of the time to midnight is $\frac{1}{2}$, or $\frac{1}{2}$ hours, and the time to midnight is 5 times $\frac{1}{2}$ hours, or $6\frac{1}{2}$ hours. Hence, the time past noon is 12 hours — $6\frac{1}{2}$ hours, or $5\frac{1}{2}$ hours ; that is, the time is 20 minutes past 5 o'clock P.M.

78. Since $\frac{1}{3}$ of the time from 9 o'clock in the morning is equal to $\frac{1}{4}$ of the time to midnight, the time from 9 o'clock in the morning is equal to $\frac{3}{4}$ of the time to midnight and $\frac{3}{4}$ of the time to midnight is equal to the time from 9 o'clock in the morning until midnight, which is 15 hours ; consequently, $\frac{1}{4}$ of the time to midnight is $\frac{1}{2}$, or 3 hours, and the time to midnight is 3 times 3 hours, or 9 hours. Hence, the time past noon is 12 hours — 9 hours, or 3 hours ; that is, the time is 3 o'clock P.M.

Page 160.

80. Since in 100 pounds of sea water there are 5 pounds of salt, or $2\frac{1}{2}$ times 2 pounds of salt, in order that 50 pounds of the new mixture shall contain 2 pounds of salt, that is, in order that for every 2 pounds of salt in the new mixture there shall be 48 pounds of fresh water, there should be in the new mixture $2\frac{1}{2}$ times 48 pounds, or 120 pounds of fresh water ; but there are only 95 pounds of fresh water in 100 pounds of sea water ; therefore, 120 — 95, or 25 pounds of fresh water must be added that 50 pounds of the new mixture shall contain 2 pounds of salt.

81. Since in 100 drops of prussic acid as prepared for medical use there are 2 drops of the pure acid, $\frac{1}{50}$, or $\frac{1}{50}$ of the mixture is pure acid ; therefore, $\frac{1}{10}$ of a drop is $\frac{1}{50}$ of a dose containing $\frac{1}{10}$ of a drop of pure acid ; and since $\frac{1}{10}$ of a drop is $\frac{1}{50}$ of 5 drops, there are 5 drops of the mixture in a dose containing $\frac{1}{10}$ of a drop of the pure acid.

82. Since the new mixture is to be $\frac{1}{3}$ tin, it will contain 4 pounds of tin to 5 pounds of lead ; and since there are 160 — 60, or 100 pounds of lead, or 20 times 5 pounds of lead, there must be 20 times 4 pounds of tin, or 80 pounds of tin, in order that the new mixture may be $\frac{1}{3}$ tin ;

but there are only 60 pounds of tin in the 160 pounds of solder ; therefore, $80 - 60$, or 20 pounds of tin must be added that the mixture may be $\frac{1}{3}$ tin.

83. Since there are to be 4 girls to 5 boys, and since there are 30 boys in the class, or 6 times 5 boys, there should be 6 times 4 girls, or 24 girls ; but there are $72 - 30$, or 42 girls in the class ; therefore, $42 - 24$, or 18 girls must leave the class so that there may be 4 girls to 5 boys.

84. Since the farmer has $\frac{1}{3}$ as many cows as sheep, he has 5 cows to 7 sheep, or $\frac{5}{7}$ of the whole number of animals are cows ; that is, he has $\frac{5}{7}$ of 120, or 50 cows.

Since there are to be 9 sheep to 5 cows, and since there are 50 cows, or 10 times 5 cows, there must be 10 times 9 sheep, or 90 sheep ; but there are $120 - 50$, or 70 sheep ; therefore, he must buy $90 - 70$, or 20 sheep that he may have 9 sheep to 5 cows.

85. Since there are 4 ounces of silver, or 10 times $\frac{2}{5}$ of an ounce of silver, in a mixture of 60 ounces of silver and copper, in order that 10 ounces of the new mixture may contain $\frac{2}{5}$ of an ounce of silver, that is, in order that for every $\frac{2}{5}$ of an ounce of silver in the new mixture there shall be $10 - \frac{2}{5}$, or $9\frac{4}{5}$ ounces of copper, there should be in the new mixture 10 times $9\frac{4}{5}$ ounces, or 96 ounces of copper ; but there are only $60 - 4$, or 56 ounces of copper in the original mixture ; therefore, $96 - 56$, or 40 ounces of copper must be added that 10 ounces of the new mixture shall contain $\frac{2}{5}$ of an ounce of silver.

Page 161.

86. Since the man spends \$160 for an equal number of sheep and lambs, paying \$5 each for the sheep and \$3 each for the lambs, he buys as many sheep and as many lambs as $\$5 + \3 , or \$8, is contained times in \$160, or 20 sheep and 20 lambs.

Since he now has as many lambs as sheep, or 20 lambs and 20 sheep, he must sell $\frac{1}{2}$ of 20 lambs, or 10 lambs, that there shall be $\frac{1}{2}$ as many lambs as sheep.

87. Since A having \$150 in a bank drew out and put into his purse as much as it already contained and then had as much in his purse as in the bank, \$150 less what he had in his purse at first equals twice what he had in his purse at first ; therefore, \$150 is 3 times what he had in his purse at first ; consequently, he had $\frac{1}{3}$ of \$150, or \$50 in his purse at first ; that is, he drew out \$50.

88. Since A had \$140 and lent B $\frac{2}{3}$ as much as B already had, A then had \$140 less $\frac{2}{3}$ as much as B had at first and B then had $1\frac{2}{3}$ as much as he had at first; but each then had the same sum; therefore, \$140 less $\frac{2}{3}$ as much as B had at first is equal to $1\frac{2}{3}$ as much as B had at first; consequently, \$140 is $1\frac{2}{3} + \frac{2}{3}$, or $\frac{7}{3}$ as much as B had at first; and since \$140 is $\frac{7}{3}$ of \$60, B had \$60 at first.

89. Since A has a farm of 250 acres and sells B $\frac{2}{3}$ as many acres as B already has, A then has 250 acres less $\frac{2}{3}$ as many acres as B had at first and B has $1\frac{2}{3}$ as many acres as he had at first; but B then has $\frac{2}{3}$ as much land as A; therefore, $1\frac{2}{3}$ as many acres as B had at first is equal to $\frac{2}{3}$ of 250 acres less $\frac{2}{3}$ of $\frac{2}{3}$ as many acres as B had at first, which is 200 acres less $\frac{4}{9}$ as many acres as B had at first; consequently, 200 acres is $1\frac{2}{3} + \frac{4}{9}$, or $\frac{14}{9}$ as many acres as B had at first; and since 200 acres is $\frac{14}{9}$ of 100 acres, B had 100 acres at first.

Since A had 250 acres at first and B had 100 acres at first, after A sold B $\frac{2}{3}$ as many acres as B already had, or $\frac{2}{3}$ of 100 acres, or 40 acres, A then had $250 - 40$, or 210 acres, and B had $100 + 40$, or 140 acres.

91. When John's age is $\frac{1}{3}$ of his father's age the difference between their ages will be $\frac{2}{3}$ of his father's age; but the difference between their ages is always the same, or $32 - 8$, or 24 years; therefore, 24 years is $\frac{2}{3}$ of what John's father's age will be when John is $\frac{1}{3}$ as old as his father; and since 24 years is $\frac{2}{3}$ of 36 years, John's father will be 36 years old; therefore, John will be $\frac{1}{3}$ of 36 years, or 12 years old.

92. When I was 3 times as old as my oldest son the difference between our ages was twice his age; but since this difference is always the same it was $60 - 30$, or 30 years; therefore, at the required time, twice my oldest son's age was 30 years; consequently, he was 15 years old. Hence, it is $30 - 15$, or 15 years since I was 3 times as old as he.

93. Since the steamer goes 5 miles downstream in the same time that it goes 3 miles upstream, its rate downstream is $\frac{5}{3}$ of its rate upstream; and since if its rate each way is diminished by 4 miles an hour its rate downstream will be twice its rate upstream, $\frac{5}{3}$ of its rate upstream less *once* 4 miles is equal to twice its rate upstream less *twice* 4 miles; consequently, $\frac{5}{3}$ of its rate upstream is equal to twice its rate upstream less 4 miles; that is, twice its rate upstream, or $\frac{2}{3}$ of its rate upstream is 4 miles more than $\frac{5}{3}$ of its rate upstream; hence, $\frac{1}{3}$ of its rate upstream is 4 miles, and its rate upstream is 3 times 4 miles, or 12 miles per hour.

Since its rate downstream is $\frac{5}{3}$ of its rate upstream, its rate downstream is $\frac{5}{3}$ of 12 miles, or 20 miles per hour.

Page 162.

94. Since at 3 o'clock the minute hand is 15 minute spaces behind the hour hand, in order that it may be 15 minute spaces ahead of the hour hand it must gain 30 minute spaces on the hour hand ; since the minute hand gains on the hour hand 11 spaces in every 12 passed over, to gain 1 space it must move over $\frac{12}{11}$ spaces, and to gain 30 spaces it must move over 30 times $\frac{12}{11}$ spaces, or $32\frac{10}{11}$ spaces. Hence, the minute hand will be 15 minute spaces ahead of the hour hand $32\frac{10}{11}$ minutes after 3 o'clock.

95. Since $2\frac{3}{4}$ gallons are $2\frac{3}{4}$ times 4 quarts, or 11 quarts, and since 11 quarts are 4 times $2\frac{3}{4}$ quarts, 11 quarts, or $2\frac{3}{4}$ gallons of vinegar will cost 4 times as much as $2\frac{3}{4}$ quarts, or 4 times 19 cents, which is 76 cents.

96. Since $1\frac{1}{4}$ bushels is $1\frac{1}{4}$ times 4 pecks, or 5 pecks, and since $1\frac{1}{4}$ pecks is $\frac{1}{4}$ of 5 pecks, or $\frac{1}{4}$ of $1\frac{1}{4}$ bushels, $1\frac{1}{4}$ pecks of cranberries will cost $\frac{1}{4}$ as much as $1\frac{1}{4}$ bushels of cranberries, or $\frac{1}{4}$ of \$1.68, which is \$.42.

97. Since the labor of 4 boys is worth as much as that of 2 men, the labor of 1 boy is worth $\frac{1}{2}$ as much as the labor of a man ; therefore, when a man can earn \$3 a day a boy can earn $\frac{1}{2}$ of \$3, or \$1 $\frac{1}{2}$ a day ; therefore, 3 boys and 4 men can earn in 1 day the sum of 3 times \$1 $\frac{1}{2}$, or \$4 $\frac{1}{2}$, and 4 times \$3, or \$12, which is \$16 $\frac{1}{2}$; hence, in 6 days, 3 boys and 4 men can earn 6 times \$16 $\frac{1}{2}$, or \$99.

98. Since the head of a fish is $\frac{2}{3}$ as long as the tail, the sum of the lengths of the head and tail is $1\frac{2}{3}$, or $\frac{5}{3}$ the length of the tail ; and since the body is 3 times as long as the head and tail together, the body is 3 times $\frac{5}{3}$, or $2\frac{1}{2}$ as long as the tail ; therefore, the length of the fish is $\frac{5}{3} + 2\frac{1}{2}$, or $2\frac{8}{3}$ as long as the tail ; but the fish is 56 inches in length ; therefore, 56 inches is $2\frac{8}{3}$ of the length of the tail, and since 56 inches is $2\frac{8}{3}$ of 10 inches, the tail is 10 inches long ; since the head is $\frac{2}{3}$ as long as the tail, it is $\frac{2}{3}$ of 10 inches, or 4 inches long ; and since the body is 3 times as long as the head and tail together, it is 3 times the sum of 10 inches and 4 inches, or 3 times 14 inches, which is 42 inches.

99. Since the loaf of bread is $\frac{1}{3}$ rye flour and the rest wheat flour, there is 3 times as much wheat flour as rye flour in the loaf ; and since wheat flour is worth 3 times as much as rye flour, the wheat flour in such a loaf is worth 3×3 , or 9 times as much as the rye flour ; therefore, the rye flour in such a loaf is worth $\frac{1}{10}$ of the value of the loaf ; and since the loaf is worth 10 cents the rye flour in it is worth $\frac{1}{10}$ of 10 cents, or 1 cent.

Since when $\frac{1}{4}$ of a loaf is rye flour, the rye flour in it is worth 1 cent, when $\frac{1}{2}$, or $\frac{3}{4}$ of a loaf of the same weight is rye flour, the rye flour in it is worth 2 times 1 cent, or 2 cents; and since there is an equal amount of wheat flour in it and wheat flour is worth 3 times as much as rye flour, the wheat flour in the loaf is worth 3 times 2 cents, or 6 cents; therefore, when the loaf is half rye the baker should receive for it 6 cents + 2 cents, or 8 cents.

100. Since the three boys share 8 sandwiches equally each eats $\frac{8}{3}$ of 8 sandwiches, or $2\frac{2}{3}$ sandwiches; consequently, since the second boy furnishes 3 sandwiches, he contributes $3 - 2\frac{2}{3}$, or $\frac{1}{3}$ of a sandwich toward the third boy's share; since the third boy pays 16 cents for $2\frac{2}{3}$ sandwiches, or $\frac{8}{3}$ of a sandwich, $\frac{1}{3}$ of a sandwich is worth $\frac{1}{8}$ of 16 cents, or 2 cents; therefore, the second boy should receive 2 cents; and, consequently, the first boy should receive $16 - 2$, or 14 cents.

101. Since A's money is $1\frac{1}{2}$ times B's, A and B together have $2\frac{1}{2}$ times as much as B has; and since C has $\frac{2}{3}$ as much as A and B together, C has $\frac{2}{3}$ of $2\frac{1}{2}$ times as much as B has, or 2 times as much as B has; hence, A, B, and C have $1\frac{1}{2} + 1 + 2$, or $4\frac{1}{2}$ times as much money as B has; but they all together have \$180; therefore, \$180 is $4\frac{1}{2}$ times as much money as B has; therefore, since \$180 is $4\frac{1}{2}$ times \$40, B has \$40.

Since B has \$40 and A has $1\frac{1}{2}$ times as much as B, A has $1\frac{1}{2}$ times \$40, or \$60; and since C has $\frac{2}{3}$ as much as A and B together, or 2 times as much as B, he has 2 times \$40, or \$80.

102. When $\frac{1}{3}$ of the time past noon is equal to the time to midnight, $\frac{2}{3}$ of the time past noon is equal to the time from noon to midnight, which is 12 hours; consequently, $\frac{1}{3}$ of the time past noon is $\frac{1}{2}$ hours, and the time past noon is 3 times $\frac{1}{2}$ hours, or $1\frac{1}{2}$ hours; that is, the time is 12 minutes past 7 o'clock P.M.

103. Since the 7 men in 5 days did 7 times 5, or 35 days' work, it would take 5 men as many days to do the same amount of work as 5 is contained times in 35, or 7 days; therefore, if the 5 men had done the entire work alone, it would have taken them 7 days longer to finish it than it did take with the help of the 7 men for 5 days; hence, in all it would have taken them $6 + 5 + 7$, or 18 days.

Page 163.

104. Since the man received, for the sheep he sold, \$10 more than the cost of the whole number, and since he reserved 10 sheep, he

gained, on the number he sold, a sum equal to \$10 more than the cost of 10 sheep; but 10 sheep at \$5 each cost 10 times \$5, or \$50; therefore, he gained, on the number he sold, \$50 + \$10, or \$60.

Since he gained \$2 per head, or \$60 on the number he sold, he sold as many sheep as \$2 is contained times in \$60, or 30 sheep; therefore, since he reserved 10 sheep and sold 30, there were in all 40 sheep.

105. Since A received \$50 for doing his part of the work, he must have plowed such a part of the field as \$50 is of \$120, or $\frac{5}{12}$ of the field; and since he plowed $\frac{1}{3}$ of the field and 5 acres more, 5 acres is the difference between $\frac{5}{12}$ and $\frac{1}{3}$ of the field, or $\frac{1}{12}$ of the field; therefore, there were 12 times 5 acres, or 60 acres in the field.

106. Since $\frac{1}{2}$ of what A cuts is 2 cords more than $\frac{1}{3}$ of what B cuts, all that A cuts is 4 cords more than $\frac{1}{3}$, or $\frac{2}{3}$ of what B cuts; therefore, A and B together cut 4 cords more than $\frac{2}{3}$ of what B cuts; but they cut 94 cords; hence, 94 cords is 4 cords more than $\frac{2}{3}$ of what B cuts; consequently, 90 cords is $\frac{2}{3}$ of what B cuts; and since 90 cords is $\frac{2}{3}$ of 40 cords, B cuts 40 cords; therefore, A cuts 94 - 40, or 54 cords.

107. Since A put in 5 horses for 4 weeks, which is the same as 1 horse for 20 weeks, and since B put in 12 horses for 3 weeks, which is the same as 1 horse for 36 weeks, they together put in the same as 1 horse for 56 weeks, and A should pay $\frac{3}{8}$, or $\frac{3}{8}$ of the cost of the pasture, which is $\frac{3}{8}$ of \$42, or \$15; consequently, B should pay the remainder, which is \$42 - \$15, or \$27.

108. Since the man can do $\frac{1}{3}$ of a piece of work in 18 days, and since 18 days is $\frac{2}{3}$ of 27 days, he can do the entire work in 27 days; since 1 man can do a piece of work in 27 days, 3 men can do it in $\frac{1}{3}$ of 27 days, or 9 days.

109. Since A and B can do a piece of work in 3 days, they can do $\frac{1}{3}$ of it in one day; since A and C can do the work in 4 days, they can do $\frac{1}{4}$ of it in 1 day; and since B and C can do the work in 6 days, they can do $\frac{1}{6}$ of it in 1 day; hence, twice what A, B, and C together can do in 1 day is $\frac{1}{3} + \frac{1}{4} + \frac{1}{6}$, or $\frac{2}{3}$ of the work; consequently, A, B, and C together can do $\frac{1}{3}$ of $\frac{2}{3}$, or $\frac{2}{9}$ of the work in 1 day.

Since A, B, and C can do $\frac{2}{9}$ of the work in 1 day and B and C can do $\frac{1}{3}$ of it in 1 day, A can do $\frac{2}{9} - \frac{1}{3}$, or $\frac{1}{9}$ of it in 1 day; therefore, he can do the whole work in $\frac{9}{1}$ days, or 9 days; similarly, B can do $\frac{2}{9} - \frac{1}{6}$, or $\frac{1}{18}$ of it in 1 day; therefore, he can do the whole work in 18 days; also C can do $\frac{2}{9} - \frac{1}{6}$, or $\frac{1}{18}$ of it in 1 day; therefore, he can do the whole work in 18 days.

Since A, B, and C can, all together, do $\frac{1}{3}$ of the work in 1 day, they can do the whole work in $\frac{1}{3}$ days, or $2\frac{2}{3}$ days.

110. Since the interest of any sum for 5 years at 6% is $\frac{30}{100}$ of the principal, $\frac{30}{100}$ of the second principal is \$150; $\frac{10}{100}$ of this principal is $\frac{1}{10}$ of \$150, or \$5; and the second principal is 100 times \$5, or \$500; therefore, the interest on the original principal is \$500.

Since the interest of any sum for 5 years at 4% is $\frac{20}{100}$ of the principal, $\frac{20}{100}$ of the original principal is \$500; $\frac{10}{100}$ of it is $\frac{1}{10}$ of \$500, or \$25; and the original principal is 100 times \$25, or \$2500.

111. Since A goes 3 rods while B goes 5, for every 5 rods that B goes he gains 2 rods on A; therefore, to gain 50 rods on A he must go as many times 5 rods as 2 rods is contained times in 50 rods, or 25 times 5 rods, which is 125 rods.

112. Since A and B start at the same point and since B goes faster than A, in order that they may be together again B must gain on A the whole distance around the island, or 72 miles; but since A goes 3 miles while B goes 4, B gains 1 mile for every 4 miles he travels; therefore, to gain 72 miles he will travel 72 times 4 miles, or 288 miles before they are together, and since he gains 72 miles on A, A will travel 288 miles less 72 miles, or 216 miles.

Page 164.

113. Since $\frac{2}{3}$ of George's money is equal to $\frac{1}{3}$ of Charles's, $\frac{1}{3}$ of George's money is equal to $\frac{1}{3}$ of $\frac{2}{3}$, or $\frac{2}{9}$ of Charles's, and George's money is equal to 5 times $\frac{2}{9}$, or $\frac{10}{9}$ of Charles's money; therefore, George has a sum equal to $\frac{10}{9} - \frac{2}{9}$, or $\frac{8}{9}$ of Charles's money more than Charles has; but George has 70 cents more than Charles has; therefore, 70 cents is $\frac{8}{9}$ of Charles's money; and since 70 cents is $\frac{7}{8}$ of 80 cents, Charles has 80 cents. Since George's money is equal to $\frac{10}{9}$ of Charles's money and since Charles has 80 cents, George has $\frac{10}{9}$ of 80 cents, or 150 cents, or \$1.50.

114. Since apples are bought at 2 cents for 3, they cost $\frac{2}{3}$ of a cent each; and since they are sold at 3 cents for 2, they are sold for $\frac{3}{2}$ of a cent each; therefore, the gain on an apple is $\frac{3}{2} - \frac{2}{3}$, or $\frac{5}{6}$ of a cent; hence, since $\frac{2}{3}$ of a cent is $\frac{2}{3}$, or $\frac{1}{3}$ of $\frac{5}{6}$ of $\frac{2}{3}$ of a cent, the gain per cent is 125%.

115. Since $\frac{2}{3}$ of one piece is 6 feet less than $\frac{2}{3}$ of the other, $\frac{1}{3}$ of the first piece is 3 feet less than $\frac{1}{3}$ of the second, and the first piece is 9

feet less than $\frac{2}{3}$ of the second; therefore, the length of the whole rope is 9 feet less than $\frac{2}{3} + \frac{2}{3}$, or $\frac{4}{3}$ of the length of the second piece; but the rope is 33 feet long; therefore, 33 feet is 9 feet less than $\frac{4}{3}$ of the length of the second piece; consequently, $33 + 9$, or 42 feet is $\frac{4}{3}$ of the length of the second piece; and since 42 feet is $\frac{2}{3}$ of $26\frac{1}{2}$ feet, the second piece is $26\frac{1}{2}$ feet long; consequently, the first piece is $33 - 26\frac{1}{2}$, or $6\frac{1}{2}$ feet long.

116. Since 3 men and 5 boys earn \$110 in a week, and 5 men and 3 boys earn \$130 in a week, 8 men and 8 boys earn \$240 in a week; therefore, 3 men and 3 boys can earn $\frac{1}{2}$ of \$240, or \$90, in a week.

Since 5 men and 3 boys earn \$130 a week, and 3 men and 3 boys can earn \$90 a week, 5 men - 3 men, or 2 men can earn \$130 - \$90, or \$40 a week; therefore, the wages of a man are $\frac{1}{2}$ of \$40, or \$20 a week.

Since 3 men and 5 boys earn \$110 a week, and 3 men earn 3 times \$20, or \$60 a week, 5 boys earn \$110 - \$60, or \$50 a week; therefore, the wages of a boy are $\frac{1}{2}$ of \$50, or \$10 a week.

117. Since the interest of any sum for 5 years at 4% is $\frac{1}{5}$ of the principal, $\frac{1}{5}$ of A's and B's money together is \$280, and the sum they had together is 5 times \$280, or \$1400.

Since $\frac{2}{3}$ of A's money is equal to $\frac{1}{2}$ of B's, $\frac{4}{3}$ of A's money is equal to all of B's, and the sum of A's money and B's money is $\frac{4}{3}$ of A's plus $\frac{1}{3}$ of A's, or $\frac{5}{3}$ of A's; but they have together \$1400; therefore, \$1400 is $\frac{5}{3}$ of A's money; and since \$1400 is $\frac{5}{3}$ of \$600, A has \$600; consequently, B has \$1400 - \$600, or \$800.

118. Since A was to have \$5 as often as B had \$4 and C \$3, and since they were to receive in all \$84, A had \$5, B \$4, and C \$3 as often as \$5 + \$4 + \$3, or \$12, is contained times in \$84; therefore, A got 7 times \$5, or \$35, B 7 times \$4, or \$28, and C 7 times \$3, or \$21.

119. Since 5 peaches are worth 25 cents, 1 peach is worth $\frac{1}{5}$ of 25 cents, or 5 cents; therefore, 12 peaches are worth 12 times 5 cents, or 60 cents; and since 5 melons are worth 12 peaches, 5 melons are worth 60 cents; therefore, 1 melon is worth $\frac{1}{5}$ of 60 cents, or 12 cents; consequently, for 12 melons there must be paid 12 times 12 cents, or 144 cents, or \$1.44.

120. Since the steamer goes downstream 12 miles an hour and upstream 10 miles an hour, it will require as many hours for it to return the distance it can go downstream in an hour as 10 is contained

times in 12, or $1\frac{1}{2}$ hours; hence, to go downstream 12 miles and return will require $2\frac{1}{2}$ hours; therefore, in 10 hours, the steamer can go downstream and back as many times 12 miles as $2\frac{1}{2}$ hours is contained times in 10 hours, or $4\frac{2}{5}$ times 12 miles, which is $54\frac{2}{5}$ miles.

121. Since $\frac{2}{3}$ of A's money is equal to $\frac{1}{2}$ of B's, $\frac{1}{3}$ of A's money is equal to $\frac{1}{4}$ of B's, and A's money is equal to $\frac{4}{3}$ of B's; therefore, A's money and $\frac{1}{4}$ of B's is equal to $\frac{4}{3}$ of B's plus $\frac{1}{4}$ of B's, or $\frac{17}{12}$ of B's, which is 2 times B's; but A's money and $\frac{1}{4}$ of B's is \$8000; therefore, \$8000 is 2 times B's money; consequently, B has $\frac{1}{2}$ of \$8000, or \$4000; and since A's money is equal to $\frac{4}{3}$ of B's, A has $\frac{4}{3}$ of \$4000, or \$5000.

122. Since a person can ride 12 miles an hour in a car and walk back 3 miles an hour, it will take him as many hours to walk back the distance he can ride in an hour as 3 is contained times in 12, or 4 hours; hence, to ride 12 miles and walk back will require 5 hours; therefore, in 10 hours, a person can ride, and walk back, as many times 12 miles as 5 hours is contained times in 10 hours, or 2 times 12 miles, which is 24 miles.

Page 165.

123. Since sea water contains 5% salt, 100 pounds of sea water will contain 5%, or $\frac{1}{20}$ of 100 pounds, or 5 pounds of salt; similarly, if a mixture is to contain 4% of salt, 100 pounds of the mixture will contain 4 pounds of salt.

Since there are 5 pounds of salt, or $1\frac{1}{4}$ times 4 pounds of salt in 100 pounds of sea water, in order that 100 pounds of the new mixture may contain 4 pounds of salt, that is, in order that for every 4 pounds of salt in the new mixture there shall be $100 - 4$, or 96 pounds of fresh water, since there is already in the water $1\frac{1}{4}$ times 4 pounds of salt, there should be in the new mixture $1\frac{1}{4}$ times 96 pounds, or 120 pounds of fresh water; but there are only 95 pounds of fresh water in 100 pounds of sea water; therefore, $120 - 95$, or 25 pounds of fresh water must be added so that 100 pounds of the mixture may contain 4 pounds of salt; that is, so that the mixture may contain 4% of salt.

124. Since $\frac{1}{3}$ of the number of dimes was equal to $\frac{2}{3}$ of the number of 25-cent pieces, $\frac{1}{3}$ of the number of dimes was equal to $\frac{2}{3}$ of the number of 25-cent pieces, and the whole number of dimes was equal to $\frac{2}{1}$ of the number of 25-cent pieces; consequently, for every 7 dimes there were 6 25-cent pieces; and since 7 dimes and 6 25-cent pieces amount to 70 cents + 150 cents, or \$2 $\frac{1}{2}$, it required as many times 7

dimes and 6 25-cent pieces to pay a debt of $\$4\frac{3}{4}$, as $\$2\frac{1}{2}$ is contained times in $\$4\frac{3}{4}$, or 2 times 7 dimes and 2 times 6 25-cent pieces, or 14 dimes and 12 25-cent pieces.

125. In order that a mixture of silver and copper may contain 5% copper, 100 ounces of the mixture should contain 5%, or $\frac{1}{20}$ of 100 ounces, or 5 ounces of copper.

Since in 80 ounces of the original mixture there are 8 ounces of copper, or $1\frac{1}{2}$ times 5 ounces of copper, in order that 100 ounces of the new mixture may contain 5 ounces of copper, that is, in order that for every 5 ounces of copper there shall be $100 - 5$, or 95 ounces of silver, there should be in the new mixture $1\frac{1}{2}$ times 95 ounces, or 152 ounces of silver; but there are only 72 ounces of silver; therefore, $152 - 72$, or 80 ounces of silver must be added that 100 ounces of the new mixture may contain 5 ounces of copper; that is, that the mixture may be 5% copper.

126. Since $\frac{2}{3}$ of the shorter piece was 10 feet shorter than $\frac{1}{3}$ of the longer, $\frac{1}{3}$ of the shorter piece was 5 feet shorter than $\frac{1}{6}$ of the longer, and the shorter piece was 15 feet shorter than $\frac{1}{6}$ of the longer piece; therefore, the length of the tree was 15 feet less than $\frac{1}{6} + \frac{1}{3}$, or $\frac{1}{2}$ of the longer piece; but the tree was 137 feet long; therefore, 137 feet is 15 feet less than $\frac{1}{2}$ of the length of the longer piece; hence, 137 feet + 15 feet, or 152 feet is $\frac{1}{2}$ of the length of the longer piece; and since 152 feet is $\frac{1}{2}$ of 80 feet, the longer piece was 80 feet long; consequently, the shorter piece was 137 feet less 80 feet, or 57 feet long.

127. Since my grocer's bill and half my butcher's bill is $\$60$, and half my grocer's bill and half my butcher's bill is $\$48$, half of my grocer's bill is $\$60 - \48 , or $\$12$, and I owe my grocer 2 times $\$12$, or $\$24$.

Since my grocer's bill and half my butcher's bill is $\$60$ and my grocer's bill is $\$24$, half of my butcher's bill is $\$60 - \24 , or $\$36$; therefore, I owe my butcher 2 times $\$36$, or $\$72$.

128. Since I gained 20%, or $\frac{1}{5}$ of the cost of the piano, I sold it for $\frac{6}{5}$ of $\$300$, or $\$360$. If I had given a discount of only 25%, or $\frac{1}{4}$, $\$360$ would have been $\frac{3}{4}$ of the list price, and since $\$360$ is $\frac{3}{4}$ of $\$480$, the list price would have been $\$480$; but I gave a further discount of 20%, or $\frac{1}{5}$; therefore, $\$480$ is $\frac{4}{5}$ of the list price, and since $\$480$ is $\frac{4}{5}$ of $\$600$, the list price was $\$600$.

129. Since the man earns $\$5$ per day and pays $\$1\frac{1}{2}$ per day for his board, he saves each day $\$5 - \$1\frac{1}{2}$, or $\$3\frac{1}{2}$; therefore, in 60 days he

should save 60 times $\$3\frac{1}{2}$, or $\$210$; but he saved only $\$160$; therefore, by being idle he lost $\$210 - \160 , or $\$50$; and since he lost $\$5$ per day by being idle, he was idle as many days as $\$5$ is contained times in $\$50$, or 10 days.

130. Since A, B, and C can do a piece of work in $1\frac{1}{3}$, or $\frac{4}{3}$ days, they can do $\frac{3}{4}$ of it in one day; and since A and B can do the work in $2\frac{1}{2}$, or $\frac{5}{2}$ days, they can do $\frac{2}{5}$ of it in one day; hence, C can do $\frac{3}{4} - \frac{2}{5}$, or $\frac{1}{20}$ of the work in one day; consequently, it will take C five days to do the work.

Since B can do the work in 5 days, he can do $\frac{1}{5}$ of it in 1 day; and since A and B can do $\frac{2}{5}$ of the work in 1 day, A can do $\frac{2}{5} - \frac{1}{5}$, or $\frac{1}{5}$ of the work in 1 day; consequently, he can do the whole work in 5 days.

Hence, A, B, and C can each alone do the work in 5 days.

131. Since 2 men can do a piece of work in 12 days, they can do $\frac{1}{12}$ of it in 1 day and 1 man can do $\frac{1}{24}$ of $\frac{1}{12}$, or $\frac{1}{24}$ of it in 1 day; since 5 boys can do the same piece of work in 12 days, they can do $\frac{1}{12}$ of it in 1 day and 1 boy can do $\frac{1}{60}$ of $\frac{1}{12}$, or $\frac{1}{60}$ of it in 1 day.

Since 1 man can do $\frac{1}{24}$ of the work in 1 day, 4 men can do $\frac{4}{24}$, or $\frac{1}{6}$ of it in 1 day; and since 1 boy can do $\frac{1}{60}$ of the work in 1 day, 2 boys can do $\frac{2}{60}$, or $\frac{1}{30}$ of it in 1 day; therefore, 4 men and 2 boys can do $\frac{1}{6} + \frac{1}{30}$, or $\frac{1}{5}$ of the work in one day; consequently, it will take them 5 days to do the work.

Page 166.

132. Since $\frac{1}{3}$ of A's money plus $\frac{1}{3}$ of B's = $\$65$, $\frac{2}{3}$ of A's money plus $\frac{2}{3}$, or all of B's = $\$195$; and since $\frac{1}{4}$ of A's money plus $\frac{1}{4}$ of B's = $\$60$, $\frac{3}{4}$ of A's money plus $\frac{3}{4}$, or all of B's = $\$120$; therefore, $\frac{2}{3} - \frac{3}{4}$, or $\frac{1}{12}$ of A's money = $\$195 - \120 , or $\$75$.

Since $\$75$ is $\frac{1}{4}$ of A's money and since $\$75$ is $\frac{2}{3}$ of $\$90$, A has $\$90$.

Since $\frac{1}{2}$ of A's money plus $\frac{1}{3}$ of B's = $\$65$, and since A has $\$90$, $\$45$ plus $\frac{1}{3}$ of B's money = $\$65$; therefore, $\frac{1}{3}$ of B's money = $\$65 - \45 , or $\$20$; consequently, B has 3 times $\$20$, or $\$60$.

133. Since $\frac{3}{8}$ of Arthur's marbles increased by 8 are equal to $\frac{1}{2}$ of the number Louis has, $\frac{1}{2}$ of Arthur's marbles increased by 4 are equal to $\frac{1}{4}$ of the number Louis has, and Arthur's marbles increased by 20 are equal to $\frac{1}{4}$ of the number Louis has; that is, the number of marbles Arthur has is equal to 20 less than $\frac{1}{4}$ of the number Louis has; then, Arthur and Louis together have 20 less than $\frac{1}{4}$ of the number Louis has and $\frac{3}{4}$ of the number Louis has, or 20 less than $\frac{1}{4}$ of the number Louis

has ; but they together have 80 marbles ; therefore, 80 marbles are 20 less than $\frac{2}{3}$ of the number Louis has ; consequently, $80 + 20$, or 100 marbles are $\frac{2}{3}$ of the number Louis has ; and since 100 is $\frac{2}{3}$ of 40, Louis has 40 marbles ; therefore, Arthur has $80 - 40$, or 40 marbles.

134. Since 7 times the first part is to be equal to 3 times the second part, the first part will be equal to $\frac{3}{7}$ of the second part ; hence, the sum of the parts will be $\frac{3}{7}$ of the second part plus $\frac{7}{7}$ of the second part, or $\frac{10}{7}$ of the second part ; but the sum of the parts is 100 ; therefore, 100 is $\frac{10}{7}$ of the second part ; and since 100 is $\frac{10}{7}$ of 70, the second part is 70 ; consequently, the first part is $100 - 70$, or 30.

135. Since the remainder is 3, if the quotient is twice the remainder, it is 2 times 3, or 6 ; therefore, the number is 6 times 8 plus 3, or $48 + 3$, or 51.

136. Since 5 times the number of oranges was equal to $1\frac{1}{2}$ times, or $\frac{3}{2}$ of the number of lemons, the number of oranges was equal to $\frac{1}{2}$ of $\frac{3}{5}$, or $\frac{3}{10}$ of the number of lemons ; therefore, the whole number of oranges and lemons was $\frac{3}{10} + \frac{10}{10}$, or $\frac{13}{10}$ of the number of lemons ; but there were 65 of both ; therefore, 65 is $\frac{13}{10}$ of the number of lemons ; and since 65 is $\frac{13}{10}$ of 50, there were 50 lemons ; consequently, there were $65 - 50$, or 15 oranges.

137. Since the amount of the principal for a certain time at 4% is \$480 and at 7% is \$540, the interest for that time at $7\% - 4\%$, or 3% is $\$540 - \480 , or \$60 ; therefore, at 1% the interest of the principal for the same time is $\frac{1}{3}$ of \$60, or \$20, and at 4% it is 4 times \$20, or \$80.

Since the principal at 4% interest amounts to \$480, and since at that rate the interest is \$80, the principal is $\$480 - \80 , or \$400.

Since in 1 year at 4% the interest on \$400 is \$16, to yield \$80 interest will require as many years as \$16 is contained times in \$80, or 5 years.

Hence, the principal is \$400 and the time is 5 years.

138. Since by advancing the price of the piano \$22, the gain is increased $2\frac{1}{2}\%$, \$22 is $2\frac{1}{2}\%$, or $\frac{2\frac{1}{2}}{100}$, or $\frac{11}{400}$ of the cost ; and since \$22 is $\frac{11}{400}$ of \$800, the piano cost \$800.

139. When John's age was $\frac{1}{2}$ of his father's age, the difference between their ages was $\frac{1}{2}$ of the father's age ; but since the difference between their ages is always the same, it was at the required time, as now, $46 - 22$, or 24 years ; therefore, at the required time, 24 years

was $\frac{1}{3}$ of the father's age; and since 24 years is $\frac{2}{3}$ of 36 years, the father was 36 years old when John's age was $\frac{1}{3}$ of his father's age; therefore, since his father is now 46 years old, it was $46 - 36$, or 10 years ago that John's age was $\frac{1}{3}$ of his father's age.

140. Since a certain number of oxen cost \$1800, and since the cost of 5 more made the entire cost \$2050, the 5 oxen cost \$2050 - \$1800, or \$250, and each cost $\frac{1}{5}$ of \$250, or \$50; but since the 5 oxen cost \$10 less each than those bought the first time, the oxen bought the first time cost \$60 per head.

Since a certain number of oxen at \$60 per head cost \$1800, there were as many oxen as \$60 is contained times in \$1800, or 30 oxen; that is, 30 oxen were bought the first time.

141. Since the difference of the numbers multiplied by itself is 100, and since $100 = 10 \times 10$, the difference of the numbers is 10.

Since one number is 10 more than the other, their sum, 40, is 10 more than twice the less. Hence, $40 - 10$, or 30 is twice the less, and $\frac{1}{2}$ of 30, or 15 is the less; therefore, the greater number is $40 - 15$, or 25.

142. Since A had $2\frac{1}{2}$ times as much money as B, and since after B had borrowed 30 cents from A they had equal amounts, the difference between what B had at first and $2\frac{1}{2}$ times what he had at first must have been 60 cents; therefore, $\frac{1}{2}$ of what B had at first equals 60 cents, and since 60 cents is $\frac{3}{4}$ of 40 cents, B had 40 cents at first; consequently, A had at first $2\frac{1}{2}$ times 40 cents, or \$1.

Page 167.

143. Since 2 of the father's steps are equal to 3 of the son's, 1 of the son's steps is equal to $\frac{2}{3}$ of one of the father's; and 5 of the son's steps are equal to $3\frac{1}{3}$ of the father's; therefore, since the father takes 3 steps while the son takes 5, in taking 5 steps the son gains on his father $3\frac{1}{3} - 3$, or $\frac{1}{3}$ of one of his father's steps; consequently, to gain 24 of his father's steps the son must take as many times 5 steps as $\frac{1}{3}$ is contained times in 24, or 72 times 5 steps, which is 360 steps.

144. Since A is to have 40 cents, or $\$ \frac{2}{5}$, as often as B has 50 cents, or $\$ \frac{1}{2}$, and C 75 cents, or $\$ \frac{3}{4}$, and since the whole sum to be divided is \$66, A will have $\$ \frac{2}{5}$, B $\$ \frac{1}{2}$, and C $\$ \frac{3}{4}$ as often as $\$ \frac{2}{5} + \$ \frac{1}{2} + \$ \frac{3}{4}$, or $\$ \frac{17}{10}$ is contained times in \$66; therefore, A's share is 40 times $\$ \frac{2}{5}$, or \$16, B's share is 40 times $\$ \frac{1}{2}$, or \$20, and C's share is 40 times $\$ \frac{3}{4}$, or \$30.

145. Since the man gains $33\frac{1}{3}\%$, or $\frac{1}{3}$ of the cost on one of the stoves, he sells it for $\frac{4}{3}$ of the cost; that is, \$40 is $\frac{4}{3}$ of the cost; therefore, since \$40 is $\frac{4}{3}$ of \$30, one of the stoves cost \$30.

Since he loses $33\frac{1}{3}\%$, or $\frac{1}{3}$ of the cost on the other stove, he sells it for $\frac{2}{3}$ of the cost; that is, \$40 is $\frac{2}{3}$ of the cost; therefore, since \$40 is $\frac{2}{3}$ of \$60, the other stove cost \$60.

Since one stove cost \$30 and the other \$60, both cost the sum of \$30 and \$60, or \$90; and since they are sold at \$40 each, both are sold for 2 times \$40, or \$80; therefore, the loss is \$90 - \$80, or \$10.

Since the cost is \$80 and the loss \$10, the loss is $\frac{1}{8}$, or $\frac{12\frac{1}{2}}{100}$ of the cost; therefore, the loss per cent is $12\frac{1}{2}\%$.

146. Since the head of a fish is 6 inches long and the tail is twice as long as the head, the tail is 2 times 6 inches, or 12 inches long; since the body is as long as the head and tail together, it is 6 inches plus 12 inches, or 18 inches long; hence the fish is $6 + 12 + 18$, or 36 inches long.

147. Since the clock gains 10 seconds in 5 minutes, or in 300 seconds, for every 300 seconds of actual time, the clock indicates 310 seconds; that is, it indicates $\frac{31}{30}$, or $\frac{10}{3}$ of the actual time; therefore, 24 hours after Monday noon, the time indicated by the clock, is $\frac{10}{3}$ of the actual time from Monday noon; but 24 hours is $\frac{10}{3}$ of $23\frac{2}{7}$ hours, or 23 hours $13\frac{4}{7}$ minutes; hence, the time is 23 hours $13\frac{4}{7}$ minutes after Monday noon, or $13\frac{4}{7}$ minutes after 11 o'clock Tuesday a.m.

148. Call the men A, B, and C. Since their rates are as 3, 4, and 5, at any time after the start, A has walked $\frac{3}{5}$ as far as C, and B $\frac{4}{5}$ as far as C; or C has walked $\frac{5}{3}$ of C's distance farther than A and $\frac{5}{4}$ of C's distance farther than B. Therefore the men will be together whenever $\frac{1}{3}$ of C's distance is an exact number of rounds; that is, when C's distance is 5 rounds or a multiple thereof. Hence they will be together for the *first* time after the start when C has gone 5 rounds, or 600 yd. At this time A has gone 3 rounds, or 360 yd., and B 4 rounds, or 480 yd.

149. Since $\frac{2}{3}$ of the length of the top is $1\frac{1}{2}$ times, or $\frac{3}{2}$ of the length of the middle piece, $\frac{1}{3}$ of the length of the top is $\frac{3}{2}$ of the length of the middle piece, and the length of the top is $1\frac{1}{2}$ of the length of the middle piece; hence, the length of the lower piece plus the length of the middle piece plus the length of the top is $\frac{3}{2} + \frac{3}{2} + 1\frac{1}{2}$, or $3\frac{3}{2}$ of the length of the middle piece, which is 4 times the length of the middle piece; but, since the tree is 170 feet high, the middle piece is $\frac{1}{4}$ of 170 feet, or $42\frac{1}{2}$ feet long; consequently, the lower piece is $\frac{3}{4}$ of $42\frac{1}{2}$ feet, or $25\frac{3}{4}$ feet long, and the top piece is $1\frac{1}{2}$ of $42\frac{1}{2}$ feet, or 102 feet long.

150. Since 80%, or $\frac{80}{100}$ of $8\frac{1}{2}$ is $\frac{2}{3}$ of $2\frac{1}{2}$, or $2\frac{1}{3}$; and since $2\frac{1}{3}$ is $\frac{3}{10}$ of 10, or $\frac{2}{3}$ of 10, 80% of $8\frac{1}{2}$ is $\frac{2}{3}$ of 10.

Since 80%, or $\frac{80}{100}$ of $7\frac{1}{2}$ is $\frac{2}{3}$ of $1\frac{1}{2}$, or 6; and since 6 is $\frac{6}{10}$ of 10, or 60% of 10, 80% of $7\frac{1}{2}$ is 60% of 10.

151. First pipe fills $\frac{1}{10}$ of cistern in 1 min.; 2d pipe fills $\frac{1}{10}$; third pipe empties $\frac{1}{15}$. $\frac{1}{10} + \frac{1}{10} - \frac{1}{15} = \frac{1}{6}$ of cistern filled in 1 min. \therefore it takes 60 min. to fill it.

Page 168.

152. 20%, or $\frac{1}{5}$ cost horse = 30%, or $\frac{3}{10}$ cost wagon; \therefore cost horse = $\frac{2}{3}$ cost wagon. Difference, $\frac{1}{5}$ cost wagon = \$100; \therefore cost wagon = \$200, and of horse \$200 + \$100, or \$300. $\$200 \times \frac{3}{4} = \250 , selling price of wagon. $\$300 \times \frac{3}{4} = \375 , selling price of horse.

153. Since by raising the price of flour 50 cents a barrel, the grocer increases his gain from 20% to 25%, 50 cents is 5%, or $\frac{1}{20}$ of the cost of a barrel of the flour; therefore, the flour cost 20 times 50 cents, or \$10 a barrel. Since the flour cost him \$10 a barrel and he sells it to gain 25%, or $\frac{1}{4}$ of the cost, he gets $\frac{5}{4}$ of \$10, or \$12 $\frac{1}{2}$ a barrel for it.

154. Since 1 yard of silk costs \$4, 40 yards cost 40 times \$4, or \$160; and since the part that was not ruined was sold so as to gain 12 $\frac{1}{2}$ %, or $\frac{1}{8}$ on the cost of the whole, it was sold for $\frac{9}{8}$ of \$160, or \$180.

Since 10%, or $\frac{1}{10}$ of the silk was ruined, there was sold $\frac{9}{10}$ of 40 yards, or 36 yards. Since 36 yards of silk were sold for \$180, the selling price per yard was $\frac{5}{36}$ of \$180, or \$5.

155. Since Mary spent for book 5¢ more than $\frac{1}{3}$ of what remained after buying doll and then had left 25¢, if she had spent for book only $\frac{1}{3}$ of what she had left after buying doll, she would then have had left 30¢; hence, 30¢ is $\frac{3}{4}$ of what she had left after buying doll; and since 30¢ is $\frac{3}{4}$ of 45¢, she had left 45¢ after buying doll.

Since she spent for doll 5¢ more than $\frac{1}{3}$ of what remained after buying ribbons and then had 45¢ left, if she had spent for doll only $\frac{1}{3}$ of what remained after buying ribbons she would then have had left 50¢; hence, 50¢ is $\frac{5}{6}$ of what she had left after buying ribbons; and since 50¢ is $\frac{5}{6}$ of 75¢, she had left 75¢ after buying ribbons.

Since she spent 5¢ more than $\frac{1}{3}$ of her money for ribbons and then had left 75¢, if she had spent only $\frac{1}{3}$ of her money for ribbons she would have had left 80¢; hence, 80¢ is $\frac{4}{5}$ of what she had at first; and since 80¢ is $\frac{4}{5}$ of 120¢, or \$1.20, she had \$1.20 at first.

156. Since length of shorter piece less 6 feet = $\frac{1}{2}$ length of longer piece, length of shorter piece = 6 feet more than $\frac{1}{2}$ length of longer piece; \therefore sum of length of shorter piece and longer piece is 6 feet more than $\frac{3}{2}$ length of longer piece; but the pole was 90 feet long; \therefore 90 feet is 6 feet more than $\frac{3}{2}$ of length of longer piece; \therefore 84 feet is $\frac{3}{2}$ of length of longer piece; and since 84 feet is $\frac{3}{2}$ of 56 feet, longer piece is 56 feet long; \therefore shorter piece is 90 - 56, or 34 feet long.

157. Since the baker charges 8 cents for a 5-ounce loaf, he should charge $\frac{2}{3}$ of 8 cents, or $\frac{16}{3}$ cents for an 8-ounce loaf when flour is the same price; therefore, when flour is $1\frac{1}{2}$ times as dear he should charge $1\frac{1}{2}$ times, or $\frac{2}{3}$ of $\frac{16}{3}$ cents, or 16 cents for an 8-ounce loaf.

158. Since the expense for each of the 12 men is reduced \$2 by taking in 8 more men, it is reduced, for the 12 men, 12 times \$2, or \$24; therefore, 8 men pay \$24, and 1 man pays \$3; and since there are in all 20 men, 20 times \$3, or \$60, is paid for the car.

159. Since 25 men engage dinner and by absence of 5 the other 20 each have to pay \$1 more, 20 times \$1, or \$20 were paid for 5 men absent; \therefore expense for each of 5 men, or for each of 25 men, was to be $\frac{1}{5}$ of \$20, or \$4; and total expense 25 times \$4, or \$100.

Page 169.

160. For every 5 rods in length there are 3 rods in breadth and 8 rods in sum of length and breadth; and since the distance around the field is 640 rods, the sum of the length and breadth is $\frac{1}{4}$ of 640 rods, or 320 rods; therefore, the length of the field is as many times 5 rods as 8 rods is contained times in 320 rods, or 40 times 5 rods, which is 200 rods; consequently, the breadth of the field is 320 - 200, or 120 rods.

Since the dimensions of the field are 200 rods and 120 rods, its area is 200×120 , or 24,000 square rods; and since there are 160 square rods in 1 acre, there are as many acres in the field as 160 square rods is contained times in 24,000 square rods, or 150 acres.

161. Int. of \$800 for $4\frac{1}{2}$ mo. = int. of \$3600 for 1 mo. Int. of \$3600 for 1 mo. = int. of \$600 for 6 mo.

162. Since the train runs 72 miles in 2 hours and 40 minutes, or $2\frac{2}{3}$ hours, or $\frac{8}{3}$ hours, in $\frac{1}{3}$ of an hour it runs $\frac{1}{3}$ of 72 miles, or 9 miles, and its rate per hour is 3 times 9 miles, or 27 miles.

163. $100 - 40 = 60$, number of boys. 60 is 80%, or $\frac{4}{5}$, of 75. There must be 60 boys out of a total of 75 pupils; \therefore 100 - 75, or 25, girls must leave.

164. Since I buy new oats for 30 cents a bushel and am to make a profit of 20%, or $\frac{1}{5}$ of the cost, the oats that cost me 30 cents I must sell for $\frac{6}{5}$ of 30 cents, or 36 cents; but since they shrink 10%, or $\frac{1}{10}$, in drying, what I bought for a bushel of oats is only $\frac{9}{10}$ of a bushel after drying; therefore, I must charge 36 cents for $\frac{9}{10}$ of a bushel of dry oats; and since 36 is $\frac{9}{10}$ of 40, I must charge 40 cents a bushel for the dry oats to make a profit of 20%.

165. Since the man after giving 10 cents each to some children had 10 cents, and since, if he had given 12 cents to each, he would have lacked 8 cents of having enough money, giving 2 cents more to each than he did, would have taken $10 + 8$, or 18 cents more than he gave; therefore, there were as many children as 2 is contained times in 18, or 9 children. Since he gave each of 9 children 10 cents and had 10 cents left, he had 9 times 10 cents, or 90 cents plus 10 cents; that is, he had 100 cents, or \$1.

166. Since there were $1\frac{1}{2}$ times as many quarters as dimes, there were $2\frac{1}{2}$ as many coins as dimes; therefore, since there were 32 coins, there were as many dimes as $2\frac{1}{2}$ is contained times in 32, or 12 dimes; hence, there were 20 quarters.

167. Since the man receives \$3 a day, he would receive at the end of 40 days, if he worked every day, 40 times \$3, or \$120.

Since for every day he was idle he lost the sum of his wages, \$3, and the cost of his board, \$1 $\frac{1}{2}$, or \$4 $\frac{1}{2}$ in all, and since his total loss was \$120 - \$75, or \$45, he has been idle as many days of the 40 as \$4 $\frac{1}{2}$ is contained times in \$45, or 10 days.

168. A and B do $\frac{1}{2}$ of the work in 1 da.; A and C $\frac{1}{3}$ in 1 da.; and B and C $\frac{1}{4}$ in 1 da. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4}$, or $\frac{7}{12}$, is twice what A, B, and C together do in 1 da.; $\therefore \frac{7}{12}$ is the part of the work they do together in 1 da.; hence, all together can do the work in $\frac{12}{7}$ da. or $1\frac{5}{7}$ da.

$\frac{8}{12} - \frac{1}{2} = \frac{1}{6}$, part of work C does in 1 da.; \therefore it takes him 48 da.

$\frac{8}{12} - \frac{1}{3} = \frac{1}{6}$, part of work B does in 1 da.; \therefore it takes him 16 da.

$\frac{8}{12} - \frac{1}{4} = \frac{5}{6}$, part of work A does in 1 da.; \therefore it takes him $9\frac{1}{5}$ da.

Page 170.

169. Since a year, or 12 months, is $\frac{1}{4}$ of $2\frac{1}{2}$ months, if a man burns $3\frac{1}{2}$ tons of coal in $2\frac{1}{2}$ months, he will burn $\frac{1}{4}$ of $3\frac{1}{2}$ tons, or $\frac{7}{8}$ tons of coal in 1 year; and since 1 ton of coal costs \$5, his coal for a year will cost $\frac{7}{8}$ of \$5, or \$96.

170. If the square root of the result is 13, the result must be 13×13 , or 169; $169 - 25 = 144$, the square of the number; $\therefore \sqrt{144} = 12$, the number.

171. For every \$8 he pays for sheep he pays $2\frac{1}{2}$ times \$10, or \$25 for hogs and \$8 + \$25, or \$33 for sheep and hogs; and since he pays \$264 for sheep and hogs, he buys as many sheep as \$33 is contained times in \$264, or 8 sheep; therefore, since he buys $2\frac{1}{2}$ times as many hogs as sheep, he buys $2\frac{1}{2}$ times 8, or 20 hogs.

172. Since $\frac{1}{3}$ of A's money increased by \$10 = $\frac{1}{2}$ of B's increased by \$18, $\frac{2}{3}$ of A's = \$18 - \$10, or \$8 more than $\frac{1}{2}$ of B's; $\frac{1}{3}$ of A's = \$4 more than $\frac{1}{6}$ of B's; and A's money = \$12 more than $\frac{1}{3}$ of B's; therefore, A's money plus B's money = \$12 more than $\frac{1}{3}$ of B's money plus $\frac{1}{3}$ of B's money, or \$12 more than $\frac{2}{3}$ of B's money; but they have together \$182; \therefore \$182 is \$12 more than $\frac{2}{3}$ of B's money; \therefore \$182 - \$12, or \$170, is $\frac{2}{3}$ of B's money; and since \$170 is $\frac{2}{3}$ of \$80, B has \$80; \therefore A has \$182 - \$80, or \$102.

173. Cost of animals, \$120; gain, \$5; selling price, \$125; $\$125 + \$2\frac{1}{2} = 50$, number of animals.

Since there were $1\frac{1}{2}$ times as many lambs as sheep, there were $2\frac{1}{2}$ times as many animals as sheep; therefore, 50 is $2\frac{1}{2}$ times, or $\frac{5}{2}$ of the number of sheep, and since 50 is $\frac{5}{2}$ of 20, there were 20 sheep; hence, there were 30 lambs.

174. Since raspberries are worth $\frac{2}{3}$ as much as strawberries, a quart and a pint of strawberries and a quart and a pint of raspberries are worth $\frac{4}{3}$ as much as a quart and a pint, or $1\frac{1}{3}$ quarts, of strawberries; but $1\frac{1}{3}$ quarts of each cost 45 cents; \therefore 45 cents is $\frac{4}{3}$ of the cost of $1\frac{1}{3}$ quarts of strawberries; and since 45 cents is $\frac{3}{4}$ of 27 cents, $1\frac{1}{3}$ quarts, or $\frac{4}{3}$ quarts of strawberries cost 27 cents; \therefore $\frac{1}{3}$ of a quart of strawberries costs $\frac{1}{4}$ of 27 cents, or 9 cents, and a quart of strawberries costs 18 cents; \therefore a quart of raspberries costs $\frac{2}{3}$ of 18 cents, or 12 cents.

175. Younger child's share will be on int. 8 yr., and older child's 6 yr.

Int. for 8 yr. @ 5% = $\frac{40}{100}$, or $\frac{2}{5}$ of principal; \therefore amt. received by younger when 21 = $\frac{2}{7}$ of his inherited share. Int. for 6 yr. @ 5% = $\frac{30}{100}$, or $\frac{3}{10}$ of principal; \therefore amt. received by older when 21 = $\frac{3}{11}$ of his inherited share. Since amounts received by each when 21 are equal, $\frac{2}{7}$ of younger's share = $\frac{3}{11}$ of older's share; $\frac{2}{7}$ of younger's share = $\frac{3}{11}$ of older's share, and younger's share = $\frac{3}{11}$ of older's share. $\frac{3}{11} + \frac{3}{11}$, or $\frac{6}{11}$ of older's share = \$2700; \therefore older's share = \$1400, and younger's share = \$1300.

176. Since, if I pay 4 cents a pound less for meat, 8 pounds at lower price will cost 32 cents less than 8 pounds at higher price; and since I can get 12 pounds at lower price for what 8 pounds would cost at higher price, I save the value of 4 pounds at lower price by buying 8 pounds at lower price rather than at higher price; therefore, 32 cents is the value of 4 pounds of meat at lower price; consequently, the value of 1 pound at lower price is $\frac{1}{4}$ of 32 cents, or 8 cents; hence, the higher price is 12 cents per pound.

177. Since the boy leaves home on his bicycle traveling at rate of 8 miles an hour and walks home at rate of 3 miles an hour, it will take him as many hours to walk back distance he can ride in an hour as 3 is contained times in 8, or $2\frac{2}{3}$ hours; hence, to ride 8 miles and walk back same distance will require $3\frac{2}{3}$ hours; \therefore since he was absent 11 hours, he rode as many times 8 miles, and walked back, as $3\frac{2}{3}$ hours is contained times in 11 hours, or 3 times 8 miles, which is 24 miles; \therefore when his bicycle broke down he was 24 miles from home.

Page 171.

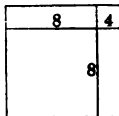
178. Since the interest for 1 year at 5% is $\frac{1}{20}$ of the principal, and the entire interest is $\frac{5}{20}$ of the principal, it will require as many years for the interest of any principal at 5% to equal 5 times the principal as $\frac{1}{20}$ is contained times in $\frac{5}{20}$, or 100 years.

179. Since the interest of any sum for 8 years at 5% is $\frac{4}{10}$ of the principal, $\frac{4}{10}$ of the second principal is \$40; $\frac{1}{10}$ of this principal is $\frac{1}{4}$ of \$40, or \$1; and the second principal is 100 times \$1, or \$100; \therefore the interest on the first principal is \$100.

$\frac{4}{10}$ of the first principal is \$100; $\frac{1}{10}$ of that principal is $\frac{1}{4}$ of \$100, or \$25; and the first principal is 100 times \$25, or \$250.

180. Since if the sides of the square are increased by 4 feet, its area will be increased 80 square feet, this will be equivalent to adding to the square a rectangle 4 feet wide and 20 feet long.

Since to have the resulting figure a square we must build on to two adjacent sides of the original square, the length of the rectangle built on is 2 times the side of the original square plus 4 feet, the side of the little square in the corner; \therefore 2 times the side of the original square plus 4 feet = 20 feet, and 2 times the side of the original square equals 16 feet; hence, the side of the original square = 8 ft.



181. Since he bought some sheep at \$5 each and 4 of them died, he lost in that way $4 \times \$5$, or \$20; and since he sold the remaining ones at \$6 per head and received as much as all the sheep cost, he must have gained \$20 by selling them at an advance of \$1 per head on the cost; \therefore he sold 20 sheep, and bought $20 + 4$, or 24 sheep.

182. 3 mi. an hour = 1 mi. in $\frac{1}{3}$ hr. uphill; 4 mi. an hr. = 1 mi. in $\frac{1}{4}$ hr. downhill. Journey of 60 mi. takes 17 hr. Divide 60 into two parts such that $\frac{1}{3}$ of 1st + $\frac{1}{4}$ of 2d = 17. If $\frac{1}{3}$ of 1st + $\frac{1}{4}$ of 2d = 17, $\frac{2}{3}$ of 1st + $\frac{1}{2}$ of 2d = 51; but $\frac{2}{3}$ of first + $\frac{1}{2}$ of 2d = 60; \therefore $\frac{1}{6}$ of 2d = 9; \therefore second = 36, and 1st = $60 - 36 = 24$. Uphill 24 mi., downhill 36 mi.

183. Since an object falls $16\frac{1}{2}$ ft. the 1st sec. and 3 times that distance the 2d sec., in 2 sec. it will fall $4 \times 16\frac{1}{2}$ ft., or $64\frac{1}{2}$ ft.

Since it falls $16\frac{1}{2}$ ft. the 1st sec., 3 times as far the 2d sec., and 5 times as far the 3d sec., in 3 sec. it will fall $9 \times 16\frac{1}{2}$ ft., or $144\frac{1}{2}$ ft.

Since it falls $16\frac{1}{2}$ ft. the 1st sec., 3 times as far the 2d sec., 5 times as far the 3d sec., and so on, in 5 sec. it will fall $1 + 3 + 5 + 7 + 9$, or $25 \times 16\frac{1}{2}$ ft., or $402\frac{1}{2}$ ft.

Similarly, in 6 seconds it will fall $1 + 3 + 5 + 7 + 9 + 11$, or 36 times $16\frac{1}{2}$ ft., or 579 ft.

184. Since it falls $9 \times 16\frac{1}{2}$ ft. the 5th sec. and $5 \times 16\frac{1}{2}$ ft. the 3d sec., it falls $4 \times 16\frac{1}{2}$ ft., or $64\frac{1}{2}$ ft. farther the 5th sec. than it falls the 3d sec.

Since it falls $13 \times 16\frac{1}{2}$ ft. the 7th sec. and $7 \times 16\frac{1}{2}$ ft. the 4th sec., it falls $6 \times 16\frac{1}{2}$ ft., or $96\frac{1}{2}$ ft. farther the 7th sec. than the 4th sec.

Since it falls $16\frac{1}{2}$ ft. the 1st sec., 3 times as far the 2d sec., 5 times as far the 3d sec., and so on, in 10 sec. it will fall $1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19$, or $100 \times 16\frac{1}{2}$ ft., or $1608\frac{1}{2}$ ft.

Page 172.

185. Cloth at \$1 for 5 yd. cost 20¢ per yd.; cloth at \$1 per 4 yd. cost 25¢ per yd. Average cost = $\frac{1}{2}$ of $(20¢ + 25¢) = 22\frac{1}{2}$ ¢ per yd.

Selling price of 9 yd. for \$2 = $22\frac{2}{3}$ ¢ per yd. Loss = $22\frac{1}{2}$ ¢ - $22\frac{2}{3}$ ¢ = $\frac{1}{6}$ ¢ per yd. \$1 or 100¢ $\div \frac{1}{6}$ ¢ = 360, number of yards bought.

186. Since the customer received only \$40 worth of sugar and paid for \$45 worth, he received only $\frac{4}{9}$, or $\frac{2}{3}$ of what he should have received; therefore, for a pound he received only $\frac{2}{3}$ of 16 oz., or $14\frac{2}{3}$ oz.

187. \$4500 + \$1860, or \$6360 = $\frac{11}{10}$ of cost of both; \therefore cost of both = \$6000. Since by selling dearer house at \$4000 and other at cost

I lose 5% of cost, sum received for both will be $\frac{95}{100}$ of \$6000 or \$5700; \therefore selling price or cost of cheaper house = \$5700 - \$4000 = \$1700, and cost of dearer house = \$6000 - \$1700 = \$4300.

188. Since $\frac{3}{4}$ number in 1st = $\frac{1}{2}$ number in 2d, $\frac{1}{4}$ number in 1st = $\frac{1}{8}$ number in 2d, and number in 1st = $\frac{2}{3}$ number in 2d.

Since $\frac{3}{4}$ number in 2d = $\frac{1}{2}$ number in 3d, $\frac{1}{4}$ number in 3d = $\frac{3}{8}$ number in 2d, and number in 3d = $\frac{4}{3}$ number in 2d.

Since number in 1st = $\frac{2}{3}$ number in 2d and number in 3d = $\frac{4}{3}$ number in 2d, the number in 3 bins = $\frac{2}{3} + \frac{2}{3} + \frac{4}{3}$, or $\frac{8}{3}$ of number in 2d.; \therefore 434, the number in 3 bins, = $\frac{8}{3}$ of number in 2d bin; \therefore number bu. in 2d bin = 144. $\frac{2}{3}$ of 144 = 162, number bu. in 1st bin; $\frac{4}{3}$ of 144 = 128, number bu. in 3d bin.

189. His commission for selling was 5% of \$1500, or \$75, and proceeds of sale were \$1500 - \$75, or \$1425; \therefore \$1425 + \$675, or \$2100, less commission for buying, = sum to be invested.

Since commission for buying = 5%, or $\frac{1}{20}$ of sum invested, \$2100 = $\frac{19}{20}$ of sum invested in flour, and sum invested = \$2000. \$2000 + \$5 = 400, number bbl. purchased.

190. Since the goods were marked 30% above cost during the 1st yr., gross gain was 30%, or $\frac{3}{10}$ of cost; expenses 1st yr. were $33\frac{1}{3}\%$, or $\frac{1}{3}$ of $\frac{3}{10}$, or $\frac{1}{10}$ of cost of goods sold.

Since 2d yr. he advanced price of goods 10%, or $\frac{1}{10}$ of marked price of year before, and since marked price year before was $\frac{13}{10}$ of the cost, marked price 2d yr. was $\frac{14}{10}$ of $\frac{13}{10}$, or $\frac{182}{100}$ of cost; hence, gross gain 2d yr. was $\frac{182}{100} - \frac{130}{100}$, or $\frac{52}{100}$ of cost of goods sold.

Since expenses 1st yr. were $\frac{1}{10}$ of cost, and since during 2d yr. they were cut down 10%, they were, during 2d yr., $\frac{9}{10}$ of $\frac{1}{10}$, or $\frac{9}{100}$ of cost of goods sold.

Hence, his net gain during 2d yr. was $\frac{43}{100} - \frac{9}{100}$, or $\frac{34}{100}$ of cost of goods sold; that is, he gained 34% during 2d yr.

